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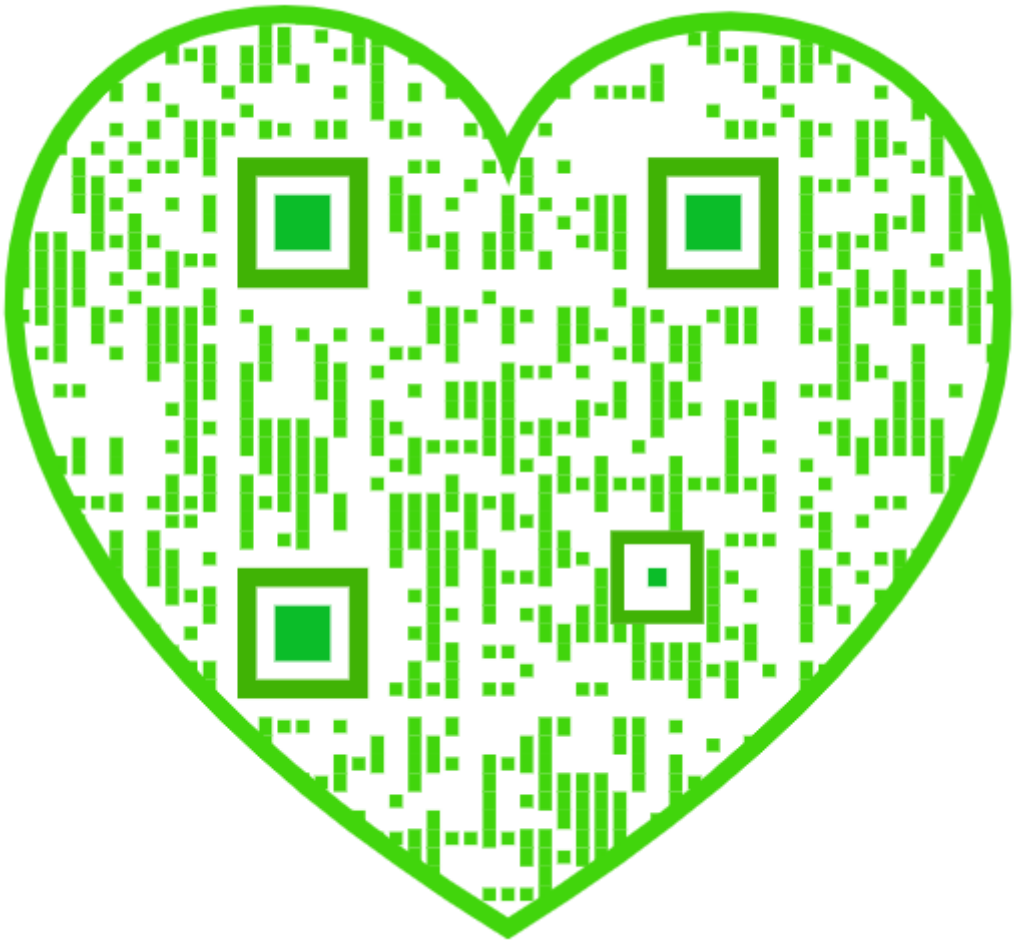

SCIENTIFIC AMERICAN

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A WEEKLY JOURNAL OF PRACTICAL INFORMATION, ART, SCIENCE, MECHANICS, CHEMISTRY, AND MANUFACTURES.

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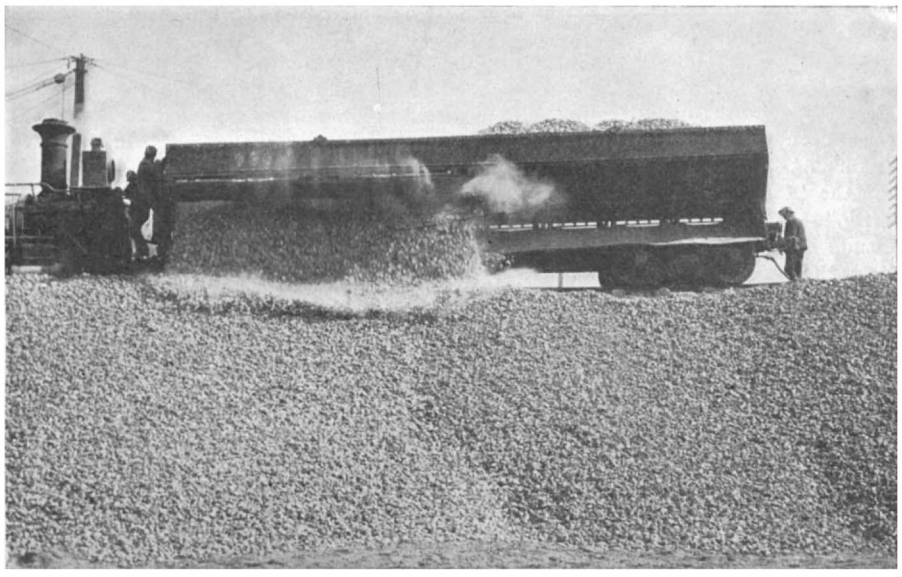
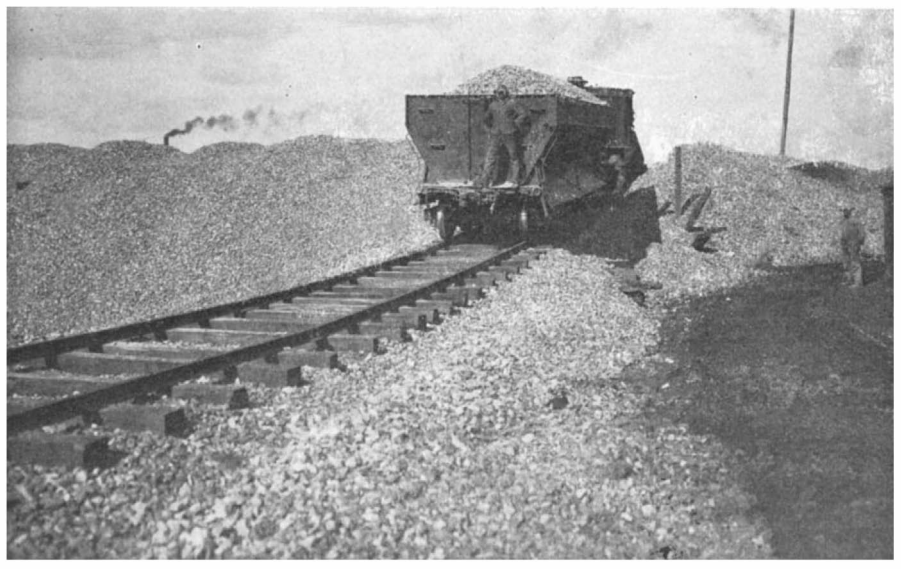
HANDLING EXCAVATED MATERIAL AT JEROME PARK RESERVOIR.

In a recent article describing the important work now being done in creating a reservoir on the site of the old Jerome race course, it was shown that the site of the reservoir is a natural depression in a high ridge of land which runs in a general north and south direction between the valleys in which are located the New York and Putnam and the Harlem Railroads. Although the site is naturally adapted for the excavation of an artificial basin, there is, nevertheless, a huge amount of material to be taken out before the reservoir will reach its designed capacity of 1,850,000,000 gallons. The completed reservoir will have a length in a north and south direction of a little over a mile, and a greatest width of half a mile, its area being 229 acres. As the whole of the bottom is being excavated to a uniform depth of 26½ feet, and the natural basin itself is filled with some stretches of high ground which rise considerably above the described high-water level of the reservoir, it can be understood that the total amount of material to be taken out reaches a very high figure; in fact, the estimated excavation at the present writing is a little under 7,000,000 cubic yards. The excavated material, however, occupies considerably more space than it did in the solid mass, the increase in the case of excavated rock being from 80 to 100 per cent. Hence it follows that the contractors, at the time the

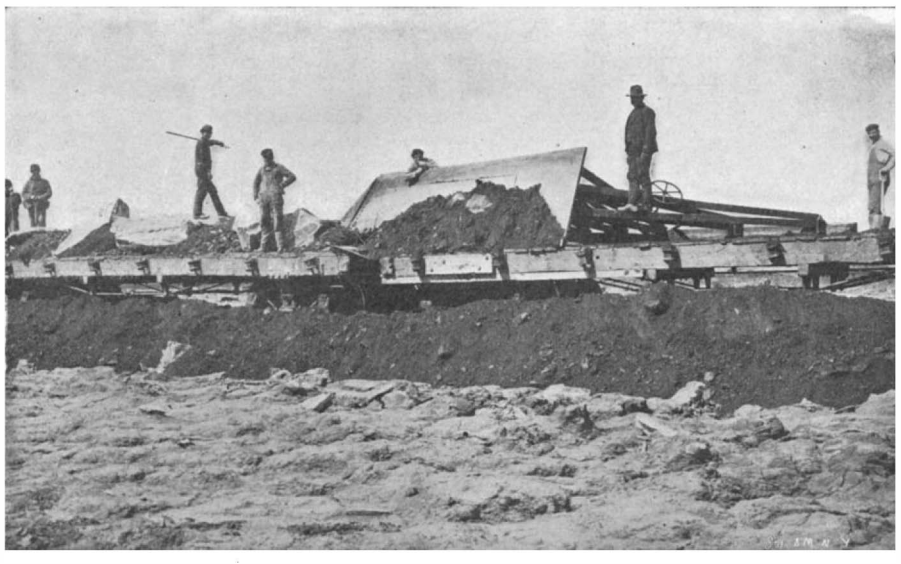
(Continued on page 6.)



Goodwin Dump Car Unloading Broken Stone.



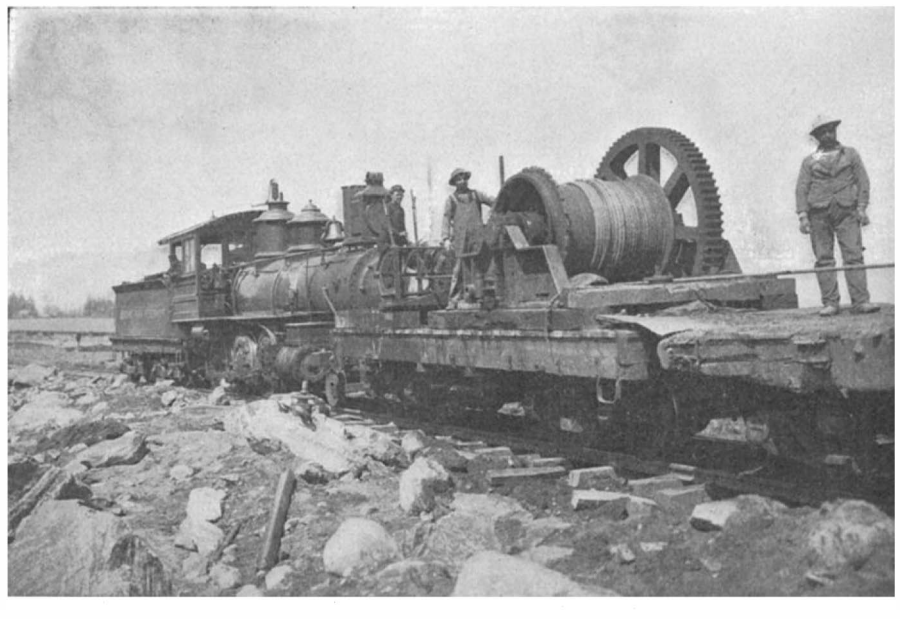
End View of Goodwin Dump Car.



Front View of the Plow, Showing Mold-Board Forcing Load from the Car.

Rear View of the Barnhardt Side Plow.

Unloading at the Dump.



Locomotive and Lidgerwood Hoisting Engine for Pulling Plow Over Train of Flat Cars.

WATER SUPPLY OF NEW YORK—HANDLING EXCAVATED MATERIAL FROM THE JEROME PARK RESERVOIR.

Scientific American.

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NEW YORK, SATURDAY, JULY 6, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

RAILROAD CONNECTIONS WITH MANHATTAN ISLAND.

There are two great engineering schemes, both vitally affecting the interests of Manhattan Island, which, thanks to one of the greatest railroad companies in this country, appear to be within measurable distance of construction. The greater of these is the proposed railroad bridge across the North River from Hoboken to Twenty-third Street. The other scheme is the proposed Long Island Railroad tunnel, which is to extend beneath the East River from the Thirty-fourth Street terminal of the Long Island Railroad Company to a terminal which will be located conveniently to the proposed terminus of the bridge. The construction of a 3,000-foot span, eight-track railroad bridge across the North River, with its costly approaches and terminals, is such a heavy financial undertaking that no private company would be capable of raising the necessary $60,000,000 or more for its construction. It has also been realized, especially during the last few years, that unless the North River Bridge is indorsed by one or more of the great railroad companies which have their terminals in New Jersey, the chances of its being built are slight. It has recently transpired, however, that at least one of the leading officials of the Pennsylvania Railroad is a director of the North River Bridge Company, and there are evidences that this powerful corporation has now taken hold of the scheme with the intention of putting it through.

The proposed tunnel beneath the East River will give the trains of the Long Island Railroad system a terminal station on Manhattan Island; and as the Long Island system has lately passed under the control of the Pennsylvania Railroad Company, it will be seen that the completion of the bridge and the tunnel will place the company in a very advantageous position as regards terminal facilities on Manhattan Island itself. In this connection also, it should be borne in mind that the company has purchased the franchise of the New York Connecting Railroad Company, which has the right to construct a railroad from a point on the main line of the Long Island road across Ward's Island and Randall's Island to a terminus within the Borough of the Bronx. Almost simultaneously comes the announcement that actual construction has commenced on a line of railroad which will connect Staten Island with Brooklyn, the line passing beneath the Narrows by means of a double tunnel. Although the Pennsylvania Railroad Company is not quoted as being directly interested in this scheme, a glance at the map will show that a connection between the main line of this road and Staten Island by a bridge across the Kill von Kull would provide an all-rail route from Philadelphia to Boston by way of Long Island and avoid the present ferriage from Jersey City, by way of the East River, to the station of the New Haven Road upon the Harlem.

There seems to be a consensus of opinion among those who are practically interested in the distribution of freight at the port of New York, that there would be no advantage in bringing freight trains across the river for distribution by rail on the Manhattan water front. It is claimed that by the present system of car floats the distribution is accomplished more speedily and with less interruption in the general traffic of the city than it could be if freight trains were brought over the Hudson by bridge and handled in the manner proposed by the New York and New Jersey Company. The new Twenty-third Street bridge will be used almost exclusively for passenger traffic. So large is the number of passengers now carried both on suburban and long-distance trains, and so rapid is the increase, that the capacity of the proposed bridge, enormous as it will be, may prove to be none too large by the time the great structure is opened.

AMERICAN LOCOMOTIVES IN ENGLAND.

Amid the considerable amount of discussion which has been aroused by the recent report upon the American locomotives on the Midland Railroad, the best statement has come from the pen of Mr. Charles Rous-Marten, than whom there is no better qualified critic upon the comparative efficiencies of various types of locomotives. Mr. Rous-Marten is well known in every part of the world where locomotives are to be found. He makes it his specialty to ride upon the foot-plate or in the cab of almost every new locomotive that has qualities of novelty or efficiency that render it worthy of special comparison with the standard locomotives already in use. This gentleman recently communicated to The Engineer an article which we reproduce in the current issue of the SUPPLEMENT. As the paper contains the observations of a man who is perfectly familiar with the work of both English and American locomotives, and who is noted as an unbiased observer, its conclusions have particular value in the present discussion.

In the first place, we gather that the test was most carefully carried out by Mr. Johnson, the Locomotive Superintendent of the Midland Railroad; that it extended over a period of six months; and that it was instituted specifically to learn what the respective merits of the two types, American and English, would prove to be under the same conditions. A superior economy was shown on the part of the English engine of twenty per cent to twenty-five per cent in fuel; fifty per cent in oil; and sixty per cent in repairs as the result of the six months' trial. At the same time the Superintendent reports that the "foreign engines worked their trains satisfactorily." Mr. Rous-Marten emphatically condemns the attitude of the non-technical press of England in taking the results of the Midland trial as proving that American locomotives, as such, are broadly inferior to those of British make. In reply to the question, "Is it not a fair comparison to have both engines made as nearly as possible of practically identical power and then to try them together on identical work?" Mr. Rous-Marten, who, by the way, is an Englishman himself, replies: "No, it is not; unless it be clear that each class of engines is the one that would be used ordinarily for the same work in the land of its origin." The Midland freight engine is the outcome of Mr. Johnson's many years of experience in judgment as to what is the best type of engine to haul a 560-ton coal-train over the Midland line; and it does the work at a low cost for fuel, oil and repairs. Now, although the American locomotives were ordered to be built of the same power as the Midland standard freight engines, "it must be noted," says Mr. Rous-Marten, "that the order to the American firms was not that the locomotives were to be of the class and power that would be employed in America to do the work required;" and just here comes in the disadvantage under which the American locomotives were laboring. If the maximum load to be hauled had been stated in the contract, and the American locomotive builders been allowed a free hand as to the size and power of locomotives which they would offer to do this particular work, they would have turned out, according to Mr. Rous-Marten, very different machines than those which were actually sent over. Thus, instead of locomotives with 18 x 24-inch cylinders and 1,200 to 1,300 square feet of heating surface, and 160 pounds of steam pressure, the American builders would probably have sent over an engine with from 1,750 to 2,500 square feet of heating surface and 180 to 200 pounds steam pressure. In other words, according to the author of the paper, American locomotive practice is based upon the principle of allowing a liberal margin of power, whereas the English locomotives, in this case at least, were designed to do just the exact amount of work specified in the contract. The argument is summed up in the statement: "Therefore the recent Midland trial only proves that identical dimensions for identical work will not suit engines of totally different designs and modes of construction."

The fact of the matter is that the question stands where it was before this trial. It is fully admitted by American builders that as a piece of high-class workmanship, the English engine cannot be improved upon for the work it has to do on English roads. But while it is granted that the English engine is longer lived, it is a question whether there is any ultimate advantage in prolonging the life of a locomotive beyond its actual period of usefulness. Here in America we have learned that the conditions of transportation change so rapidly that the ideal locomotive of one decade may have outlived its usefulness in the next. The English always aimed at a high theoretical performance in their locomotives, and unquestionably they have secured it; but they have secured it at the expense of certain elements which go to make up successful railroad operation. If there were less expensive finish on the engines, and less successful effort to prolong their life beyond the period at which, in this country, they would be sent to the scrap heap, it is quite possible that the shareholders of the English railroad companies and the traveling public themselves would be gainers.

HEIGHT OF OCEAN WAVES.

There has been a good deal written lately about the height of ocean waves. An article in our contemporary Knowledge has been largely quoted, in which the writer gives some very interesting figures regarding observations made in the South Indian Ocean, between the Cape of Good Hope, and the Isles of St. Paul and New Amsterdam, this being a region where westerly winds prevail almost without a change the year around. It was in this locality that the highest waves on record, according to the writer, were observed, the measurement of thirty waves at various times during the day showing an average height of 29.63 feet, the largest of observed waves being 37.53 feet in height. Lieut. Paris, who made the observation, had to climb to the twenty-second rung of the shrouds before he obtained the level of the crest.

In these days of colossal steamers, with towering superstructures, it is not necessary to do any climbing of the shrouds to observe the height of the waves. Going from deck to deck, the passenger, with a little experience, can find a position in which sitting or standing the crest of the highest waves will just coincide with the line drawn from his eye to the horizon. He can probably ascertain from one of the officers of the ship what is the height of the deck on which he is standing; adding to this the distance from the deck to his eye, he can obtain a fairly approximate estimate of the height of the waves. In making an estimate of this kind, however, care should be taken to make the observations when the vessel is in the trough between two big seas, and on a fairly even keel, the observer standing amidships and as near as possible to the center line of the vessel. The upper deck of the biggest of the Atlantic steamships is from 30 to 32 feet above the normal waterline, and it is very rarely, even in the heaviest Atlantic storms, that the crest of a wave will reach the height of the observer's eye. When it does, it is probable that the ship herself is moving over one of the cross seas which frequently intersect the regular line of Atlantic rollers.

Perhaps the most accurate gaging of the height of ocean waves ever carried out was that which was recently discussed in a paper before the Institution of Civil Engineers of Great Britain by William Shield, who gave the results of observations made during a storm at Peterhead, North Britain, when the wind varied in velocity from 50 to 90 miles an hour. The method of observation was as follows: Sights were taken along the breakwater with a view to ascertaining the height of the waves as they ran into the bay between the breakwater and the opposite shore. The water along the line of the sights was from 60 to 63 feet in depth. The sights, which were 6½ feet in height, were placed at intervals of 120 feet along the coping of the breakwater, the level of which is 22 feet above low water. As the tide-gage registered 9 feet at the time the observations were taken, the line of sight must have been 19½ feet above still-water level. According to Mr. Shield, wave after wave passed by carrying an unbroken crest at least 3 feet above the line of sight and, therefore, 22½ feet above the still-water level. The wave-period varied from 13 to 17 seconds, and the length of the waves between 500 and 700 feet. Assuming that the troughs of the waves were as far below the still-water level as their crests were above it, the height of the waves would appear to have been 45 feet; but it is recorded that the flatness of the trough curve as compared with the curve of the crest seemed to indicate that the height of the crest above and the depth of the trough below the still-water level were not identical. It was considered by the author of the paper that the crests of the waves were to some extent raised by the friction of the sea-bed. Hence, it was estimated that, on the ground that the volume of water above the still-water level must correspond with that of the trough below it, the height of the waves from trough to crest closely approximated to 40 feet. These figures, it will be observed, are greater than those recorded as having been observed in the South Indian Ocean and elsewhere, due allowance being made for the tendency of the waves to become steeper and loftier as the friction of the sea-bed tells upon them.

SELENIDES OF COBALT.

M. Fonzes-Diacon has been carrying on a series of experiments relative to the combinations of selenium and cobalt, and has succeeded in forming a number of new compounds, the selenides of cobalt, which are analogous to the series of selenides of nickel recently described before the Academie des Sciences. The only previous preparation of the selenide of cobalt is that of Little, who formed a melted protoselenide by the action of selenium upon cobalt heated to redness. The protoselenide was the first body obtained by M. Fonzes-

Diacon, who was, however, unable to produce it in the crystalline state. The action of selenium vapors upon cobalt causes the metal to become covered with a gray deposit which is easily detached and corresponds to the formula CoSe; it is an amorphous body. The oxide of cobalt is also transformed to the same compound by the action of hydrogen selenide at a bright red heat. The sesquiselenide of cobalt was the second of the series formed by the experimenter. At low redness, hydrogen selenide reacts upon anhydrous chloride of cobalt and transforms it to sesquiselenide; this body has the form of a gray melted mass, and analysis gives it the formula Co_2Se_3. Another selenide having the formula Co_3Se_4 is obtained in the crystalline state by heating chloride of cobalt to low redness in a tube and passing over it a current of hydrogen selenide drawn through by a current of nitrogen charged with vapors of hydrochloric acid. At the end of the operation a brilliant crystalline mass is obtained, of gray-violet color, which under the microscope appears in fine octahedra, isolated, of the cubic system. The crystals have the formula Co_3Se_4 and are thus isomeric with the mineral linneite, having the same composition. Its density at 15 degrees C. is 6.54. The biselenide of cobalt was next found by the reaction of hydrogen selenide upon anhydrous chloride of cobalt considerably below a red heat, and the latter is transformed into a brittle mass of gray-violet color, having the composition $CoSe_2$. It easily loses selenium by the action of heat. The different selenides mentioned are partially reduced when heated to bright redness in a current of hydrogen and a silver white and brilliant mass is formed, which has the formula Co_2Se, being a subselenide. The experimenter then describes the properties of the new selenides. When reduced to powder they are slowly attacked by hydrochloric acid vapor at low redness, and the strong acid has but little action, even at the boiling point. Bromine water dissolves them easily; when heated in a current of oxygen they give rise to selenious anhydride and oxide of cobalt. Hydrogen, at a red heat, transforms them to subselenide, which by a prolonged action loses a further proportion of selenium. The oxyselenide is another new body formed in the experiments; seleniate of cobalt heated in a current of hydrogen is at first partially dissolved with loss of selenious anhydride and water, then at a higher temperature, below redness, a reduction takes place with the formation of a greenish-gray powder containing variable quantities of selenium and cobalt and also of oxygen. If the reduction takes place at a low red heat a black magnetic powder is formed, which is a mixture of metallic cobalt and its selenide. Lastly, at a white heat a gray and porous mass is obtained, which consists of metallic cobalt containing small quantities of selenium. As a result of these experiments it is found that cobalt will combine with selenium, forming four different bodies according to the conditions of temperature—$CoSe_2$, Co_2Se_3, Co_3Se_4, CoSe. At a high temperature these bodies are transformed by hydrogen into the subselenide Co_2Se. The seleniate of cobalt, reduced by hydrogen, gives oxyselenides or mixtures of selenide and metallic cobalt, according to the temperature.

COKE AS A SUBSTITUTE FOR ANTHRACITE COAL.

BY ALTON D. ADAMS.

Deposits of anthracite coal, thus far worked in the United States, are of smaller extent and much more concentrated geographically than are those of the bituminous varieties. Statistics of coal production show the influence of these conditions, in an annual output of bituminous fully three times as great as that of anthracite coal for the entire country. The average value of the bituminous coal at the mines is only about one-half as great per ton as that of the anthracite. Moreover, the annual supply of bituminous coal is capable of a much larger increase, without raising the price per ton, than is the case for anthracite. Over a large part of the country the uses to which the two varieties of coal are applied are in large measure distinct. Anthracite generally has the decided preference for residences and in city buildings, while bituminous coal is much more extensively used in industrial operations. Railway locomotives consume large amounts of both hard and soft coal, some roads using one and some the other variety, but the anthracite is much the more satisfactory, because of the great reduction of smoke and cinders where it is used. The limited area and amount of anthracite coal deposits, the difficulty of the mining operations, over those of soft coal, and industrial conditions that frequently result in strikes on the part of the miners, all tend to render the supply of anthracite coal to some extent uncertain. Considering the comparatively high price of hard coal and the elements of uncertainty in its supply, it seems that some substitute for it, free from these objections and also from the disadvantages of soft coal, would be of great advantage to the public. It is evident at the start that any substitute for anthracite that is to have extensive use must be derived from bituminous coal, since natural gas is only available over a limited area and is failing in quantity, while the supply of petroleum is too small in total amount and its price too high, to admit of its general application to fuel purposes. As is well known, soft coal suffers by comparison with hard, because the former is not as readily burned in ordinary stoves and furnaces, and unless special precautions are taken gives off on combustion a dense black smoke. If these undesirable properties can be removed from soft coal or its products, without too much expense, a cheap and desirable substitute for hard coal may be provided. The different results attained in the combustion of anthracite and bituminous coals are mainly due to their chemical compositions. Good anthracite coal consists, on an average, of about 88 per cent fixed or solid carbon, 4 per cent volatile matter, in the form of hydrocarbons, and 8 per cent ash. An average value for the composition of bituminous coal is approximately 60 per cent fixed carbon, 32 per cent volatile matter and 8 per cent ash. The main difference between hard and soft coal, is thus the presence in the former of a much larger proportion of fixed carbon and but a fraction of the volatile hydrocarbons that are found in the latter. It is the presence of this large per cent of hydrocarbons in bituminous coal that interferes with its satisfactory combustion in ordinary stoves and furnaces, besides producing the black smoke and soot that are mixed with the air in most places where soft coal is extensively used for fuel. The fact that the hydrocarbons found in soft coal can be driven off by heat, leaving the fixed carbon in solid form, is taken advantage of for two distinct purposes, the production of coke for metallurgical uses, and the supply of illuminating gas. The distillation of bituminous coal in each case produces both gas and coke, but where the main object is to obtain coke, the gas is usually wasted, while in the manufacture of illuminating gas the by-product coke is somewhat inferior in quality for metallurgical uses. A good grade of coke is a very satisfactory fuel for general use in almost all kinds of stoves and furnaces, as well as for special purposes in the industrial arts. As coke is even more nearly composed of pure carbon and ash than is anthracite coal, its employment entirely avoids the smoke nuisance. A sufficient supply of good coke at competitive prices would render private consumers, large city buildings, and such railways as require a smokeless fuel, to a large extent independent of anthracite coal. Such a coke supply would not do away with the use of anthracite coal, but would divide the market with it, and expand in use whenever the production of hard coal was restricted by any unusual cause. While there is an almost unlimited field for the solid product of the distillation of bituminous coal, the gas developed seems equally certain to find a demand beyond any probable production for many years to come. It is quite certain that the present use of illuminating gas for fuel and power is held in check by the comparatively high prices of energy from this source. A large reduction in the present rates for gas would result in a great increase of its use for heat and power.

One ton of fairly good gas coal may be taken to yield, when treated in retorts, 10,000 cubic feet of gas and 1,300 pounds of coke on an average. About 300 pounds of coke, when used as fuel for the retorts, are required to distill one ton of coal, so that the net products of gas and coke are 10,000 cubic feet of the former and 1,000 pounds of the latter per ton of coal. In addition to the coke and gas, each ton of average coal yields about 120 pounds of tar and 200 pounds of ammonia liquor. The accounts of quite a large number of gas companies show that more than one-half of their total outlay for coal is recovered by the sale of coke, tar and ammonia. Allowing that only one-half of the cost of the coal consumed is received for the residual products of gas manufacture, the net outlay for coal to produce a thousand cubic feet of gas is obviously very small. For example, if gas coal costs three dollars per ton, and one-half of this amount is recovered for the by-products, the net charge for coal against the 10,000 cubic feet of gas obtained from one ton is $1.50, which corresponds to fifteen cents per 1,000 cubic feet.

The wide difference between this last figure and the current charges for gas includes the cost of enrichers, the various items in manufacture, such as labor, interest, depreciation, repairs, distribution charges and profits. If the gas is not enriched, the entire cost of oil, some of the plant equipment and a part of the labor item are saved. The result is a gas of about ten per cent smaller heating capacity than the enriched product usually distributed, but of a much larger reduction in cost. It seems evident from these facts that a large plant, producing coke and simple coal gas, would be able to offer both the gas and coke at prices decidedly lower than are charged by existing plants that operate primarily for the manufacture of enriched illuminating gas, a product that necessarily can find only a comparatively limited demand, at the rates for which it must be sold. Such cheap gas and coke would supply much of the demand now met by anthracite coal.

SCIENCE NOTES.

A Dublin firm has produced a typewriter writing Irish characters.

It is said that the trials of the flying machine which has been under construction for some time by Denny Brothers have been satisfactory, showing that the principle is all right but the motive power is inadequate. The machine is 40 feet from tip to tip of the wings, and the weight, including that of the two aeronauts, is about 600 pounds.

The density of population in foreign countries has recently been computed. Great Britain takes the lead with 132 inhabitants per square kilometer, which is equal to 0.3861 square mile; then comes Japan, 114.4; Italy, 106.6; the German Empire, 104.2; then comes Austria, 87; Hungary, 59.6; France, 72.2; Spain, 35.9; the United States, 8.4; Russia, 5.9.

Twenty thousand dollars has been collected for a statue of Virgil at Mantua, Italy, his birthplace. This city formerly had a statue of him, but it was destroyed in 1397, so that for over five hundred years the great Latin poet has been without a monument. A portrait of him was discovered in Tunis two years ago, so that the monument of Mantua ought to be a correct representation of the author of the "Æneid."

Dr. H. S. Gaylord, of the University of Buffalo, states that cancer is caused by an animal parasite which has been identified and isolated. He has been investigating the cause of cancer for two years as head of the New York State Pathological Laboratory. He has inoculated animals with cancer germs, and cancer afterward developed in the animals. Cultures of these organisms have been injected in the abdominal cavities of other animals and they recovered, having apparently grown in the serum of the animal.

An instance of the inexplicable conservatism and arrogance of the Turkish customs authorities was recently evidenced by the prohibition of the importation of typewriters into the country. The reason advanced by the authorities for this step is that typewriting affords no clew to the author, and that therefore in the event of seditious or opprobrious pamphlets or writings executed by the typewriter being circulated it would be impossible to obtain any clew by which the operator of the machine could be traced. A large consignment of 200 typewriters was lying in the custom house at the time the above law was passed, and as there is no apparent possibility of the authorities repealing their ridiculous decree, the machines will have to be returned. Efforts are being made by the various embassies to induce the authorities to assume a more reasonable attitude. The same decree also applies to the mimeograph and other similar duplicating machines and mediums.

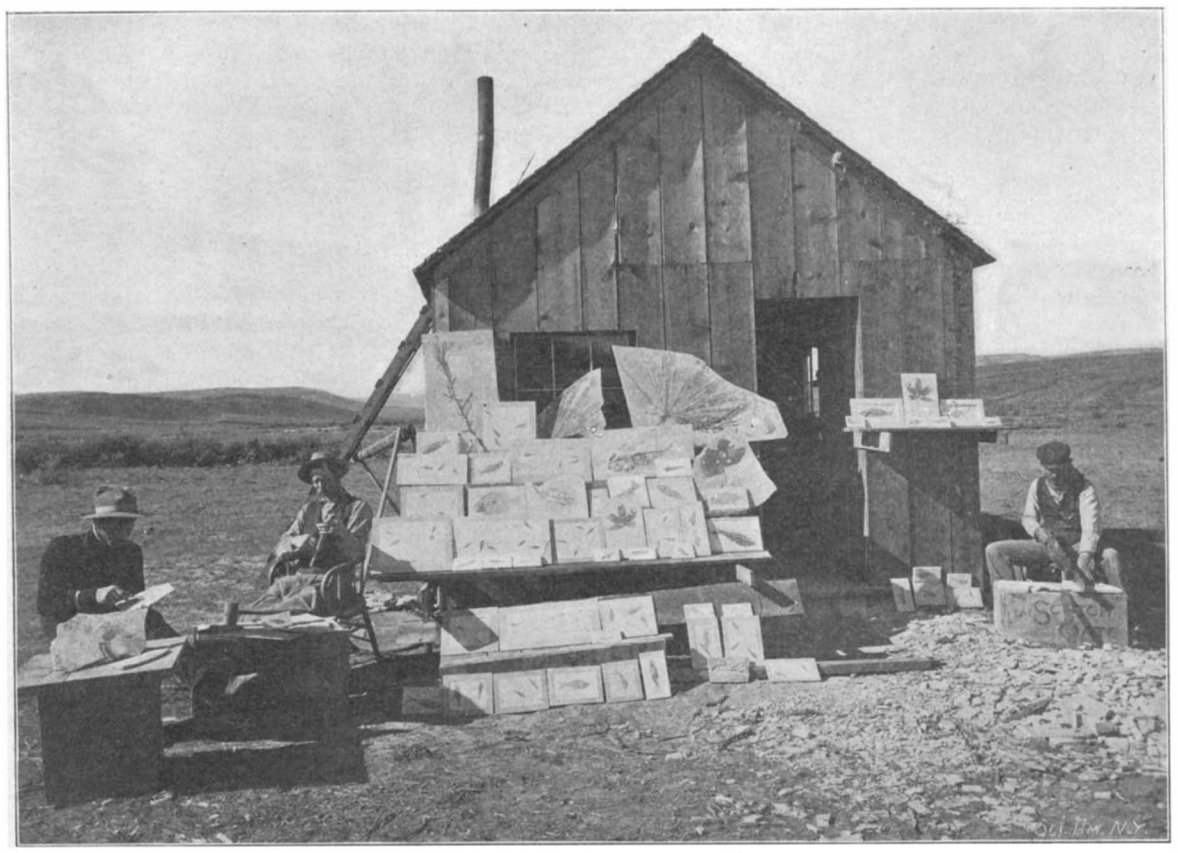
The American branch of the Society of Psychical Research of Boston has issued a circular for the sentiment of people regarding a future life. They are desirous of obtaining statistics on this subject. The questions which they ask are, first, would you prefer to live after death or not; second, do you desire future life whatever its conditions may be? If you do not prefer to live after death, what would the character of the future life be to make the prospect seem tolerable? Would you, for example, be content with a life more or less like your present life? Can you state what elements in life were felt by you to call for its perpetuity? Third, can you state why you feel this way, as regards questions one and two? Fourth, do you now feel the question of a future life to be of urgent importance to your mental comfort? Have your feelings on questions one, two and four undergone change? If so, when, and in what way? Sixth, would you like to know for certain about the future life, or would you prefer to leave it a matter of faith?

Ordinary gypsum is brittle, porous, hygroscopic and by the absorption of water becomes a good electrical conductor, but in the hardened condition it is useful for parts which do not require to withstand powerful tension or high and sudden changes of temperature. Gypsum may be hardened by the following methods: (*a*) The powdered gypsum is intimately mixed with 2 to 4 per cent of powdered marshmallow root and with 40 per cent water kneaded to a paste. After an hour the mass is so hard that it may be filed, cut, or bored; an addition of 8 per cent marshmallow root powder makes it thicker. Marshmallow root powder may be replaced by dextrin, gum arabic or glue. (*b*) Gypsum, 6 parts, is mixed with freshly slaked lime, 1 part, and when the required shape is made it is moistened with a concentrated solution of magnesium sulphate. (*c*) The gypsum, after burning, is digested with 10 per cent solution of alum and after drying again burnt; on the addition of water the gypsum crystallizes to a marble-like mass, the so-called marble cement.—Pharm. Centralh., 41, 779.

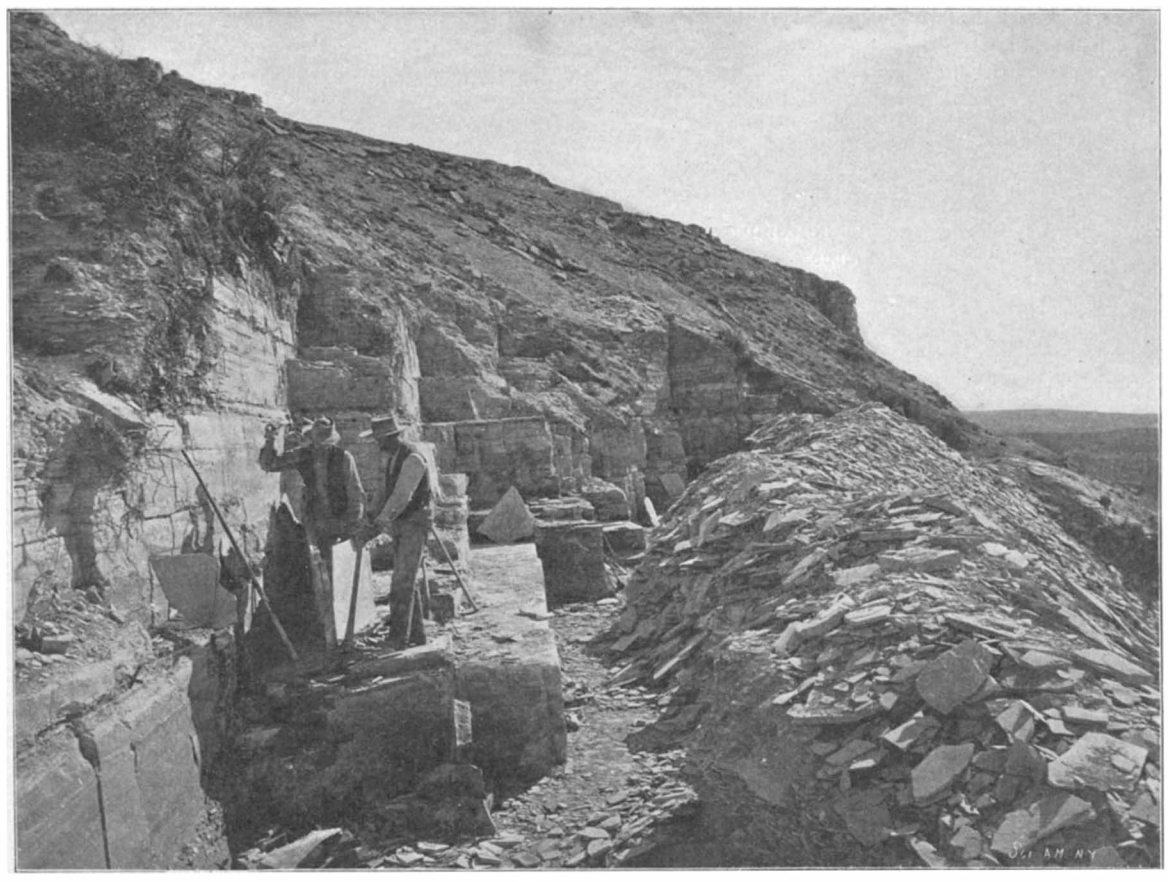
A WYOMING FOSSIL QUARRY.

The State of Wyoming is a geological wonderland, and the reason for this is, that geologically speaking it is the newest land on the continent. The Mesozoic period has left rich fossil deposits in this State, the remains varying in size from little invertebrate ammonites to the giant vertebrate dinosaurs of the Jurassic age. In 1899 a thoroughly organized scientific expedition, composed of eighty members, spent some forty days in exploring and examining the fossil exposures and gathering specimens, and the result of their labors was fully described in the SCIENTIFIC AMERICAN of December 16, 1899.

We now illustrate and describe a fossil quarry where smaller specimens are found, situated in the extreme southwestern part of Wyoming, near the town of Kemmerer, at the summit of a mountain 8,200 feet above the sea level. The geological formation is known as the "Green River Tertiary." The shale is laminated and carboniferous and some streaks are bituminous, carrying paraffine and oil in large quantities. The quarry is worked exclusively by hand, that is to say, no blasting operations are carried on. The shale is split into slabs, broken with sledge hammers and thrown over the bank by hand. Our engraving shows the shale formation, which ends a few feet above the heads of the men. From the top of its level to the "floor," a few feet below where they are standing, the shale contains fossils. When the slabs containing the specimens are cut and taken out, they are very moist and are dried out to about a third of their original weight before the cleaning process begins. It is difficult to clean the fossils when the shale is too dry, for the impressions are exceedingly thin and it requires the utmost skill and care to clean the more delicate specimens. Knives and saws made especially for the purpose are used. The hut or cabin is situated at the foot of the mountain, more than a mile from the quarry, and the workmen bring the slabs to this place to prepare them. The specimens when they are properly cleaned are exceedingly beautiful, the fishes with all their bones outlined being especially interesting. The Green River fishes are considered the finest specimens of fossil fishes, although they may not be more perfect, as far as skeletons are concerned, than those from Monte Bolca, Italy. The Monte Bolca specimens are in a softer and more chalky stone than those from Wyoming, and hence do not present so fine an appearance. The collections from the Green River Tertiary are not, however, rich in species. We are indebted to Mr. A. J. Livingston, of Butte, Mont., for our photographs.



PREPARING AND CLEANING THE FOSSILS.



THE FOSSIL QUARRY, KEMMERER, WYOMING.

Improvement in Steel Rails.

BY WILLIAM GILBERT IRWIN.

For some years the various railroad companies have been endeavoring to secure rails of a harder quality, the heavy modern locomotives and steel cars frequently breaking down the ordinary rail. For several years the American Society of Civil Engineers has been investigating the resistance strength of steel rails, and the tests made by this body have fully demonstrated the fact that the softness in steel rails is due to the method of rolling rather than to any defect in the composition of the steel.

As well known, the Carnegie Steel Company, of Pittsburg, Pa., is one of the largest manufacturers of steel rails in the country, and when, a few months ago, a number of the leading roads gave notice that their future orders for rails would carry with them a proviso that the rails should be treated after the manner suggested by the American Society of Civil Engineers, this big concern soon devised a way in which these requirements might be met. Steel men have known for years that the manner in which steel is worked has much to do with its quality, so the Carnegie Company set about to make improvements in the methods of rolling rails. In some of the experiments it was found that several of the methods by which the improvement of the product might be accomplished would necessarily curtail the output of the plant.

It was the object of the Carnegie Company to secure the desired improvement without any decrease in the output. It was generally agreed that in order to accomplish the desired improvement it would be necessary to roll the rails at a lower temperature than the ordinary white heat in which the customary shapes are so easily obtained; but there was great danger of this reduced heat working to the deterioration of the product by reason of physical changes during the rapid cooling. The difficulty, however, has been successfully overcome by the Carnegie Company, and the new process for improvement in the manufacture of rails is now in successful operation at the Edgar Thomson plant of that company.

It has been found that by reducing the temperature of the unfinished rail before it passes through the finishing roll, the product is brought up to the standard of hardness which the railroads are now demanding. In the new process, as conducted at the Edgar Thomson mills, the rails are allowed to cool from thirty to forty seconds before being passed through the third or finishing set of rolls. This is accomplished by means of a cooling table which is so arranged that it does not interfere with operations, the roughing of the rails proceeding while the cooling is going on. Under the new arrangement the unfinished rails are shoved out under the rolls onto the cooling table, with the head of the hot rail placed next to that of the one which preceded it. Being thus placed, the flange, which is thinner, cools at about the same temperature as the head, the heat being equalized so that the flange is not in a different condition from the thick head in the final rolling.

It is generally conceded that this invention is one of the most important discoveries made in the steel industry for many years. A very peculiar fact in relation to the new process is that Thomas Morrison, superintendent of the Edgar Thomson Steel Works of the Carnegie Company, and Julian Kennedy, a well-known Pittsburg mechanical engineer, both made the same discovery within a few days of each other and neither knew of the other's work along this line. Both made application for the same patent at about the same time; but since that time they have combined their interests, and the new process, which will be known as the Kennedy-Morrison patent for rolling steel rails, will be used exclusively by the Carnegie Company.

The chemical tests made of the new process show that by the slower radiation of heat and by working the steel colder, a loss of carbon is prevented, with a greater resulting hardness. The delay in completing the final process of rolling gives greater tensile strength in the physical test, and the microscopic test shows that the rails contain a finer and more even fiber.

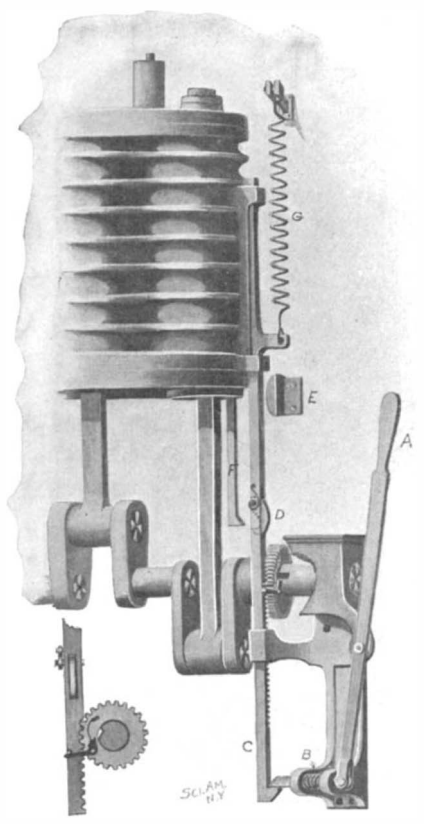
Importance of Apples.

The statement made in the Independent that the value of the apple crop of this country is greater than that of its wheat production will bring a surprise to many. Thus it is stated that the total yield of apples in 1900 was 215,000,000 barrels. Supposing that an average price of $2 a barrel was obtained, the aggregate value of the crop was $430,000,000. The average value of wheat is but a little over $300,000,000 annually. By this estimate the apple crop is worth about 50 per cent more than our wheat. The export of apples exceeds 4,000,000 barrels a year and it is increasing. The price abroad ranges from $2 to $4 a barrel, the most of the fruit bringing nearer the larger price. Its production ranges over a wide extent of country, though few sections of it make the apple their chief reliance for support.

Prof. Dewar, in a recent lecture before the Royal Society, reduced hydrogen to a solid and announced that a temperature had been produced which was eight or ten degrees lower than this, or within nine degrees of the absolute zero. He is sanguine of success in the liquefaction of helium. Another gas must be found even more volatile than helium in order to reach within one degree of absolute zero.

A STARTING-DEVICE FOR HYDROCARBON MOTORS.

Mechanical devices for starting hydrocarbon motors have been invented, but have never been widely used for the reason that they are too often expensive, cumbersome, and inefficient. The chauffeur has therefore decided to retain the customary hand-wheel, by the turning of which he finally succeeds in inducing the gascline motor of his automobile to start. A mechanical starter of unusual simplicity has, however, been



A STARTING-DEVICE FOR HYDROCARBON MOTORS.

invented by Dr. Z. S. Taylor, of 29 West 126th Street, Manhattan, New York city, that seems to be free from the faults which marked the old contrivances and which shows an intelligent endeavor to overcome hitherto apparently insurmountable difficulties. On the driving shaft of his engine Dr. Taylor loosely mounts a pinion, meshing with a rack, *C*, controlled by a coil-spring, *G*. The pinion can be locked to the shaft by means of a spring-pressed pawl designed to engage a notch in the shaft. Normally the pawl is held out of engagement with the shaft-notches by a pin on the rack.

Near its middle the rack carries a pivoted spring-pressed catch, *D*, designed to engage the hooked end of a rod, *F*, secured to the piston. To throw the catch, *D*, into the path of the rod, *F*, a cam, *E*, is employed.

The outer end of the rack, *C*, is also hooked to engage a spring-pressed catch, *B*, operated by the lever, *A*.

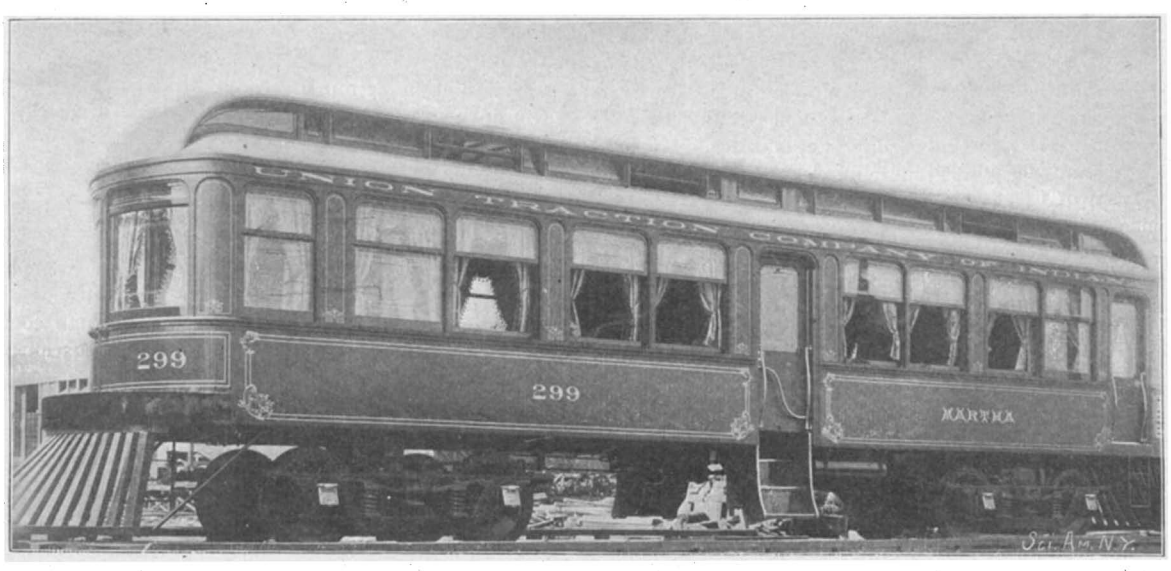
In order to start the engine, the lever, *A*, is swung over to withdraw the catch, *B*, from the rack-hook, whereupon the spring, *G*, pulls the rack inwardly. This movement of the rack withdraws the pin on the rack from the pinion-pawl, whereby the pawl is forced by its spring into the shaft notch, thus locking shaft and pinion together, and causing the shaft to turn. The rotary movement given to the shaft causes the drawing in of an explosive charge into the cylinder, so that an impulse is given to the piston after ignition.

At the end of the rack's travel the catch, *D*, is projected by the cam, *E*, into the path of the hook on rod, *F*. On the out stroke of the piston, the rack is consequently moved back against the tension of its spring, *G*, and is automatically locked to the catch, *B*. And there the rack remains until again released by the lever, *A*.

A TROLLEY PALACE CAR.

Our engraving shows the new palace car "Martha," built for General-Manager George F. McCullough, of the Union Traction Co. of Indiana, by the St. Louis Car Company, of St. Louis, Mo. The conditions which led to the building of this car are peculiar. The Traction Company has a terminal in cities like Indianapolis, Anderson, Muncie and Marion; the system is 140 miles long and competes for traffic with steam roads for most of its length. The presence of the General-Manager is required at various centers, and in order to be able to move quickly from place to place, the car was designed so as to afford him an office on wheels, and, if necessary, a home as well. The total cost of the car was $12,000, probably the largest sum ever expended for a single electric car. It is 60 feet long, and there is a cowcatcher on each end of the car. It is mounted on two four-wheel trucks, and is equipped with two 250 horse power motors, so that it can attain a speed of 60 miles an hour if desired. It is equipped with Christensen air brakes.

The decorations and furnishings are most elaborate. It is painted a dark olive green, and in some of the panels we read "Martha." The interior finish is French Renaissance. One apartment is termed the red room, the other the green room. The finest South African mahogany and the finest plate glass are used, and the carvings are most elaborate. The ceilings are light blue and are decorated. The red room contains two desks, one for the general-manager, and the other for his stenographer. It also has a buffet, bookcase, water coolers, etc., in addition to two folding tables. In the rear end of the car there is a smoking compartment. The green room is fitted with an upper and lower berth, a complete bath room and lavatory, and kitchen with the necessary utensils and a china closet and ice box. There is a small compartment for the motorman at each end of the car. There are four electric chandeliers, two in each compartment, and 25 single lamps, so that there is ample light. The furnishings are the most elaborate which could be provided, the chairs being upholstered in silk damask except the office chairs, which are covered with red leather. Electric call bells are in every compartment, and in fact there is every convenience which could be looked for in any private car of a railroad president on a steam line.



PALACE TROLLEY CAR FOR A GENERAL MANAGER.

New Breech-loading Quick-firing Gun.

The British Naval Department are introducing a new breech-loading quick-firing gun into the great 18,000-ton battleships which are now in course of construction. The diameter of the bore is 7.5 inches and its total length from breech to muzzle is 386.7 inches. The gun weighs 15¾ tons and is equipped with a shield weighing 12 tons 16 hundredweight. The weight of the projectile is 209 pounds, which is twice the weight of that utilized with the 6-inch gun. The charge is 79 pounds of nitro-cellulose, which imparts a velocity of 3,000 feet per second and an energy of 12,480 foot-tons. The breech mechanism is very ingenious, being of a new hand-lever type, by which means the breech is opened and closed by a single motion of the lever. The one horizontal swing of the hand lever rotates the breech plug, swings it in and out of the gun, and cocks the firing striker. Considering its size it is the most powerful weapon is existence. It is more than twice the length of the former 6-inch gun and exceeds in length the former earlier type of 12-inch gun.

Iron-plating a Lighthouse.

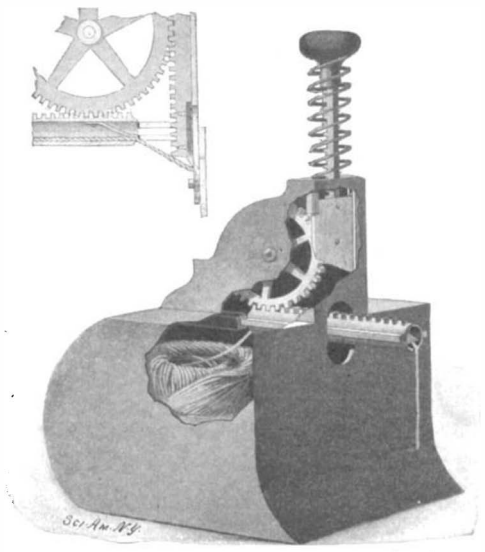
An ingenious use of steel plates has been made at a lighthouse at Grande Pointe au Sable, in Michigan, says The Architect. The lighthouse, which is about 80 feet high, is formed of brick with a stone base. It was erected in 1867, but almost from its completion it has suffered from the violent rain storms of the district. For a long time pointing was undertaken regularly, but at length it was determined to incase the lighthouse with metal. The bent plates used varied from 5-16 inch to 3-16 inch in thickness, and they were united by means of angle bars. As a further precaution, a space was allowed between the brickwork and the metalwork, which was filled in with concrete. The work was carried out by Mr. E. L. Woodruff, and the total cost has been about $5,000. For that outlay a serviceable lighthouse has been secured, and it is believed that owing to the success of the experiment several others of the numerous lighthouses that are required near the big lakes and rivers of America will be treated in a similar way.

A NOVEL TWINE HOLDER AND CUTTER.

A device which is specially adapted for guiding and cutting twine to be used in tying up packages has recently been patented in the United States by Raymond D. Weakley, of St. Louis, Mo.

As our illustration shows, the device comprises essentially a lower compartment and an upper compartment, the former of which contains the ball of twine and the upper of which incloses the operative mechanism.

This operative mechanism comprises a toothed wheel meshing with a rack formed on a carrier. The carrier is tubular in form and receives the free end of



A NOVEL TWINE HOLDER AND CUTTER.

the twine. A spring in the carrier prevents the twine from slipping.

Below the opening in the casing through which the carrier normally projects a knife is secured. In the upper section of the casing a plunger surrounded by a coiled spring is mounted, the plunger being provided with a rack which likewise meshes with the toothed wheel. When the plunger is partially depressed the toothed wheel is turned; whereby the carrier is forced within the casing. When the plunger is depressed to its fullest extent, a blade attached to its lower end will pass the fixed blade previously mentioned and sever that portion of the twine which extends through the opening in the casing. As soon as the plunger is released it will be restored to its normal position by the coiled spring.

Wood in Battleships.

The British Admiralty has always evinced an inexplicable partiality for the extensive employment of wood, even in their most modern battleships. Naval experts of every other country have almost unanimously considered this a grave error on the part of the British, while one authority even went so far as to remark that the latest battleships in the English navy would burn like tinder in a battle. It is indispensable that a certain amount of woodwork should be present in a warship, but the quantity should be restricted to the irreducible minimum. Not only does the presence of woodwork constitute a serious danger from fire, but it offers a severe menace to the crew, who would in all probability suffer extensively from flying splinters. This fact was incontrovertibly established in the course of the experiments with the old "Belleisle." The British Admiralty has attempted to remedy this defect by the use of non-inflammable wood. This, however, did not prove entirely satisfactory, and a short while ago it was announced that this chemically-treated wood would be no further employed. Now the Admiralty has gone a step further, and has announced that wood will not be used in future in the construction of battleships except where rendered absolutely necessary. There will be no wooden decks, and the cabins are to be built of steel, lined with corticine. This decision, it is stated, is due to the investigations of the havoc wrought upon the "Belleisle" and marks a decided step forward. Several new features which are being introduced into the British warships now in course of erection are attributed to the same cause, so that the object lesson given by the "Belleisle" has not proved unavailing. All those vessels now on the stocks which are not too advanced will have the woodwork removed and steelwork substituted.

HANDLING EXCAVATED MATERIAL AT JEROME PARK RESERVOIR.

(Continued from first page.)

excavation is completed will have handled about 10,000,000 cubic yards of material, measured at the dump.

It is evident, then, that the question of getting out the rock, sand and earth, is only part of the problem, for this huge quantity has to be carried away and deposited on suitable dumping-grounds. Fortunately, there are within the boundaries of New York city, and within convenient distance of the reservoir, certain low-lying, swampy lands which must be filled in or reclaimed, if they are to be rendered serviceable; and for this work of refilling the Jerome Park material offers an abundant supply. Of 4,000,000 cubic yards which have been taken out to date, about 20 per cent has been used in filling near the Kingsbridge road and in Bronx Park. For the disposal of the other 80 per cent a single line of track has been laid for a distance of 4 miles, through Bedford Park, across the Harlem Railroad tracks, through Bronx Park and down Pelham Bay Parkway to the stretch of tide lands formed by the head waters of Westchester Creek and Westchester Bay, which is known as the Meadows. Commencing where the Parkway leaves the edge of the sloping grounds, this enormous mass of 3,200,000 cubic yards of sand, gravel, hardpan and solid rock has been dumped out upon the tide lands, until now a large proportion of a square mile has been filled in to a depth of 18 to 20 feet.

The illustrations which accompany this article show the modern methods of handling and transporting this material, without which the cost of carrying it away for a distance of 4 miles and dumping it would be vastly increased. At the reservoir the cars are run in trains of from ten to fifteen cars alongside the bluff which is being excavated, and the material is loaded by derricks, if it be rock, or by steam diggers if it be soft or loose material, directly on to the flat-cars. The train-load is then run down to the Meadows, where the engine is uncoupled and a train of empties coupled on, to be taken back to the reservoir. The train-load of material is now unloaded by means of a huge scraper-plow which is known as the Barnhardt Side Plow. The unloading locomotive engine, of which there are several employed at the dump, has coupled in front of it a strongly-built flat-car, upon which is bolted a Lidgerwood hoisting-engine of 180 horse power. The locomotive with its hoisting-engine car is backed down and coupled to the front end of the train-load of material, while at the rear of the train is coupled up the car on which is mounted the massive side plow. The latter is so clearly shown in our illustration that it needs no detailed description. The face of the mold-board is a heavy plate of steel, which extends diagonally across the car, the rear edge of the mold-board projecting slightly beyond the side of the car platform. The line side of the plow consists of a heavy stick of timber which is shod with steel. A 2-inch steel cable extends from the head of the plow across the whole length of the train to the hoisting-engine, and short heavy stakes are set in the stake-pockets on the right-hand side of each car to form an abutment for the line side of the plow, and keep the plow on the cars and up to its work. The mold-board is backed up by a series of vertical oak timbers from which a series of diagonal struts, heavily reinforced with iron, extend to the timber on the land side of the plow. When the train has been run into the desired position, the hoisting engine is started and the whole contents of the train are crowded off the cars, as shown in our illustrations. The saving in time and labor is considerable, as may be judged from the fact that in unloading a train of fifteen cars the services of 150 men are dispensed with, that number being necessary to unload a train with the ordinary laborer's shovel. Moreover, it would take this number of men from fifteen to twenty minutes to do the work which is now accomplished by the plow in five minutes.

Another labor-saving device for the rapid unloading of material, which is also extensively used at Jerome Park Reservoir, is the Goodwin Patent Dump Car, of which we present two views. In cross-section the car is of hopper form. The sloping sides of the car are hinged so as to open outwardly, the hinges being locked by suitable catches. When the dumping-place is reached the catches are released, and the whole contents of the car are immediately discharged, as shown in our snapshot view taken at the instant of unloading.

The railroads of Africa are of considerable extent. Their total length is 12,498 miles. In Algeria, Tunis, French Sudan, Somaliland, the mileage is 3,428. In British East, South and Central Africa, the Gold Coast and Lagos, the mileage is 3,381. Egypt has 2,036 miles of road; the Transvaal, 1,202; Natal, 736; the Orange Colony, 597; Angola and Mozambique, 585 miles; Congo Free State, 275 miles; German East and West Africa, 186 miles; Erythrea, 16.7 miles.

Automobile News.

Automobile traffic is receiving much attention in Sweden. It is probable that this summer a French company will run cars in the city of Stockholm for public hire, while a syndicate has been formed for the running of combined passenger and goods cars between the Anundsjö railway station and the province of Vesterbotten, in the north of Sweden, the former being open in the summer in order to allow tourists a good view of the fine scenery in these parts. The maximum speed is to be fifteen kilometers an hour.

The various tests for heavy-weight motors have been carried out under the auspices of the Liverpool Self-Propelled Traffic Association, which is the local center of the Automobile Club of Great Britain. The principal trials were hill-climbing, with and without loads and maneuvers at the St. George's Docks. Twelve vehicles entered the competition, the idea of which was to demonstrate that goods could be as easily and as quickly carried by this means as by the railroad. The vehicles ranged in carrying capacity from 1½ to 5 tons, and in speed from 5 to 8 miles per hour. At present the motor car traffic is handicapped by the legislated tare limit of three tons, and with such a low tare it is absolutely impossible to run heavy goods motors at a profit. Attempts are being made to either have this limit removed or to have it increased.

The motor omnibuses in London have been withdrawn from the streets owing to the indifferent support which they received from the public. The vehicles were faster than the horse omnibuses at present in existence. It is intended to retain the vehicles, since it is anticipated that when motor traffic becomes more developed and popular they will be in demand. It is intended to utilize the present storage depot, which is more than adequate to accommodate the omnibuses owned by the company, for the purpose of housing, repairing, and maintaining any type of automobiles, and also to charge electric motors and to supply petrol spirit. It is anticipated that this selling of power will be sufficiently lucrative to support the company until the time arrives when they can place motor omnibuses in the streets and maintain a regular and profitable service.

The Shrinkage of Natural Gas.

The value of the natural gas supply in the West has been such as to convert otherwise unfavorable localities into thriving industrial towns and manufacturing centers, and in some places the gradual exhaustion of the fields of gas has reconverted the communities into deserted towns and villages very much as the exhaustion of gold mines repeatedly did in California and Colorado. It was not many years ago that consumers looked upon the supply of natural gas as something without end or limit, and for decades the gas was foolishly wasted. The notes of warning which were sounded some ten years ago have in recent years been heeded, and in most localities the gas is carefully saved from all waste. But this has not come about until almost too late in some sections, and the pressure is reduced almost to the point where it hardly pays to use it.

Formerly the gas was used freely without any attempt being made to measure it, but to-day consumers have their gas supplied to them through meters, and they pay for the quantity they use. This system has abated the wasteful methods, and it is estimated that one cubic foot to-day accomplishes as much as three cubic feet did before. In lighting purposes the gas is further saved by using the incandescent mantles, which gives a certain light at much less expense than when the gas is burned alone without the mantles. In the distribution of the gas in Pennsylvania there are several other methods for preventing waste, the most important of which is the use of smaller size mains.

The reduction in the pressure of the gas is the first and pretty evident sign that the supply is giving out, and in most of the old gas regions this pressure has decreased marvelously, while in a few new ones, such as in West Virginia, there has so far been no diminution in the pressure. At one of the earliest natural gas regions operated, the State of Pennsylvania shows the greatest evidence of gas exhaustion, and at the same time the companies operating the wells have shown the most desire to economize in the sale and distribution of it. Regions that were formerly dependent upon the gas for fuel and for house heating are gradually abandoning natural gas for these purposes, but it is being employed for other industries in which it pays better. The natural gas engines have greatly multiplied in Pennsylvania, and they are being used more every year. Natural gas engines for pumping wells can be used much more advantageously than steam. This is particularly true where the pipes have to run a long distance. The loss of steam through condensation in passing through a long steam pipe is great, while there is absolutely no loss in conducting the natural gas through the longest pipes. A growing use of the gas is for operating air compressors, and then the rest of the machinery is run by the compressed air. This has been found to be the most economical use of the natural gas engines. Some of the largest iron and steel mills in Pittsburg have natural gas pipes running into them, and certain kinds of machinery are operated entirely by this fuel. There are over 5,000 miles of natural gas pipes in Pennsylvania, and these distribute the fuel to widely separated interests and territories.

Nevertheless, the pressure has been steadily decreasing in Pennsylvania, where the value of the product declined from $19,282,375 in 1888 to $6,242,543 in 1897, and even to a much further limit in 1900. But through the economizing of the gas for manufacturing purposes it is possible that the supply will last many years yet in some regions, while in others the life of the wells cannot be estimated at more than five or ten years. New wells are constantly being drilled, but the proportion of paying ones to the unprofitable ones is steadily decreasing, while old wells are being annually abandoned.

In Indiana, where there are nearly 5,000 miles of natural gas pipes, the pressure has declined quite rapidly in some regions in the past ten years. From 1886 to 1897 the pressure fell from 325 pounds to 195 pounds, according to the State Geologist's report, while in 1898 it fell to 181 pounds. When it is understood that practical workers in the field believe that when the pressure gets below 100 pounds to the square inch the majority of the wells cannot be worked profitably, the importance of this steady reduction in the pressure can be appreciated. The natural gas in the Trenton limestone rocks of Indiana is found at a depth of 1,000 feet, and this extreme depth makes the sinking and operation of wells expensive.

In Fairfield County, Ohio, which supplies gas to such cities as Columbus, Lancaster, Athens and Chillicothe, the wells are sunk to an average depth of 2,000 and more feet, and the pressure is 800 pounds to the square inch. This field is comparatively new, and new wells have been rapidly sunk there, and the pressure has not materially declined. In the northwestern part of Ohio, however, the decline in the pressure has been from 450 pounds in 1888 to 30 pounds in 1897. There are about 600 producing wells in this part of the state, and fully half a hundred are abandoned every year, while a large percentage of the new ones drilled do not produce. The condition of the fields is thus far less encouraging than formerly, and in the past decade the value of natural gas in Ohio has declined from a little over five million dollars to less than two millions. As in Pennsylvania, the use of the gas has greatly changed in recent years, and companies are making every effort to economize with it.

The natural gas supply of New York, Illinois, Kansas and Missouri is far less than either of the other states mentioned, but the pressure has also steadily decreased in these portions of the country. The work of sinking new wells in these states has declined because the companies have found less and less profit in the enterprise. Some old gas sections are entirely abandoned, and the wells now in operation hardly supply enough to feed the industries dependent upon the fuel.

In West Virginia and Canada the use of natural gas has increased in recent years, and these two fields have great promises. In 1888 there was hardly a dozen natural gas wells producing in West Virginia, while in 1897 there were over 150, of which 47 had been drilled in the last six months. To-day there are upward of 250 producing wells in the state, with new ones being steadily sunk. The depth of the wells in that state varies from 1,200 to 2,800 feet, and the cost of drilling runs from $1 to $1.50 per foot. The pressure varies fully as much as the depth of the wells. In some of the new wells it has been found to be as high as 1,100 pounds to the square inch, and in other places it rarely reaches 100 pounds. This great difference in the pressure makes the matter of exhaustion very uncertain, but experts believe that with proper care and avoidance of waste the West Virginia gas regions will continue to supply this valuable fuel for many years to come. Certain it is that there is no sign of exhaustion to frighten the owners for the next decade.

Canada is a rich natural gas region which has only been recently tapped, and in the last few years several hundred miles of pipes have been laid to bring the gas into the United States. Like the mineral resources of Canada, the natural gas supply north of us is only poorly understood or measured, and for all that we know there are fields of it sufficient to keep our industries going for half a century. But in this country, especially in the old regions where gas has been used for years, the supply is steadily decreasing, and some industries that were originally built up by the cheap fuel have either changed their location or made preparations to adopt other fuel. At present all efforts are being made to prolong the life of the wells that are already in operation. As the pressure of the gas decreases the wells are apt to fill with water, and this greatly diminishes their usefulness. Trouble of this kind is constant, and a good deal of extra engineering work is required to keep the wells free from the water.

G. E. W.

Correspondence.

The Factor of Safety in Yachts.

To the Editor of the SCIENTIFIC AMERICAN:

In reading "The Factor of Safety in Shamrock," by your English correspondent, in SCIENTIFIC AMERICAN of June 1, I am led to offer a suggestion which may explain why relief could not be given when the flaw struck the "Shamrock" which carried away her mast, the same failure of relief reaching similar result in the case of the "Constitution."

The first question any practical yachting man asks on reading of such an accident is, "Why was not the helm put down, and the ship luffed into the wind to relieve the strain?"

In the account of the "Shamrock" accident we are told that the helm was "jammed hard down," but she would not come into the wind. The reason for this state of affairs lies in the construction of these modern racing craft. Every one of them carries a lee helm, and to that degree that they are dangerous vessels. The faulty construction that involves this condition is the tremendous forward rake of the sternpost. Were this built more nearly upright, after the old manner, the rudder would get a better hold on the water, and the ship would respond to the movements of the helm.

In the modern racer, the moment she heels at all, her entire waterline is changed and lengthened, and the rudder acts merely as a narrow knife, running its point into the water, its blade insufficiently inclined to the plane of the vessel's progress through the water to have any effect in throwing her head into the wind.

The only relief from this condition is either to set the sternpost more nearly vertical, as in older constructions, or to have sheets of the head sails so that they can be immediately freed, which latter seems hardly practicable in such large craft. Crowninshield tried to overcome the difficulty in the "Independence" by means of a balance rudder. This is a good solution of the difficulty in small vessels, but strength and weight of materials forbid it in the big racing machines.

SPENCER BORDEN.

Fall River, Mass., June 24, 1901.

The Restoration of Star Photographic Negatives.

All astronomical photographers realize the importance of washing their plates thoroughly, but in spite of this fact they are very prone to fade. Negatives, of course, are carefully preserved as a record, and the plates lose their value if any of the star images have faded. Sir William Crookes, editor of The Chemical News, was called in to restore some missing star images on a valuable series of plates taken nine years before. The process which he used was his own invention, and he described it as follows:

1. Soak the plate in distilled water for three hours.
2. Prepare, in advance, two solutions, A and B.

SOLUTION A.

Pyrogallic acid	1 ounce.
Sodium metabisulphite	1 ounce.
Water	80 ounces.

SOLUTION B.

Sodium carbonate (crystals)	12 ounces.
Sodium sulphite	4 ounces.
Water	80 ounces.

Mix equal parts of A and B, and allow the plate to soak in the mixture for ten minutes or a quarter of an hour, in the dark. Wash well.

3. Transfer the washed plate to a solution of 3 ounces of sodium hyposulphite in 20 of water. Allow it to remain for half an hour, and then wash the plate in running water for three hours.

4. Prepare a "clearing" solution according to the following formula:

Alum	1 ounce.
Citric acid	1 ounce.
Ferrous sulphate	3 ounces.
Water	20 ounces.

Allow the plate to soak in this for ten minutes and then remove and wash in running water for six hours.

5. Prepare, in advance, two solutions, C and D.

SOLUTION C.

Ammonium sulphocyanide	100 grains.
Water	10 ounces.

SOLUTION D.

Gold chloride	15 grains.
Water	15 ounces.

For use take 1 ounce of each, and add 8 ounces of water. Soak the plate in this mixture for ten minutes, and at the end of that time remove and wash it in running water for half an hour. Transfer to a dish of distilled water, where it may remain for an hour. Finally drain on blotting paper and allow to dry.

The separate solutions A, B, C, D, will keep for an indefinite time, and the same may be said of the clearing solution, if kept tightly corked. But when mixed together they will not keep, so fresh mixtures should be made each time.

I have given you the full process adopted on the plates you sent me, but I think some of them may be omitted with no disadvantage. For example, I should like to try if the soaking in hyposulphite may be dispensed with. I think it can, but I only tried leaving it out on the plates you sent that had not faded.

I always found the great secret of preventing images from fading out was to wash them very well in running water. The clearing solution allows the time of washing to be a little shortened, but not much.

The sulphocyanide and gold solution has the property of precipitating gold on the image and rendering it of a blacker color and diminishing the chance of fading. I should think you would find it useful always to use the clearing solution in your usual process.

Electrical Notes.

The municipal council of St. Petersburg is to send an electrical expert to the United States in order that he may study the telephone system of this country with a view of reorganizing the one in use in St. Petersburg.

An attachment is provided in Sweden by which the secrecy of the telephone line is assured. The apparatus, which is rented at a moderate rate, indicates whether the telephone operator is listening to the conversation or not.

Mr. Marconi has a motor-carriage which is equipped with a folding cylinder on top of the car and devices for the transmission of wireless telegraphic signaling. Motor cars fitted with this device are to be used in the forthcoming military maneuvers.

The vibrations caused by the new electric underground railway in London have been so great that a committee has been appointed to investigate this difficulty. It was found that a large proportion of the locomotives were not borne by springs and that the rails lacked rigidity. A new type of locomotive has been ordered.

All British battleships and cruisers in commission for home stations, and all vessels being prepared for the Reserve, Training, and Channel Squadrons, are to be fitted with wireless telegraphy apparatus. All future battleships and cruisers sent to the Mediterranean are also to be so equipped. Apps-Newton coils are being used.

The traffic on the new electric underground railways in London and Paris is about the same. The total number of passengers carried from July 30 to December 31, 1900, was 14,458,405 for the London road, and 15,890,526 for the Paris line. The receipts are highest for the English road, but the London road cost much more to build, the expense being $2,806,000 per mile, while the French road cost only $1,403,000 per mile.

In a paper read recently before the Société Internationale des Electriciens, M. Picou, who was the engineer-in-chief for the electricity supply service at the Paris Exhibition, gave some figures as to the output and power consumption. The total duration of the electricity service was 2,756 hours, during which public lighting was supplied for 909 hours, and the average number of hours of running of the generators was 713.5. The total connections to the mains represented 11,265 kilowatts—practically 20,000 horse power. The mean daily output of the generators was 25,336 kilowatt hours.

The Chicago & Milwaukee Telegraph Company has announced that it will transmit telegrams between Milwaukee and Chicago at the rate of ten cents for ten words, and one cent for each additional word, says The Railway Review. The lines of this company have heretofore been used almost exclusively for board of trade business, but have now been opened for a general commercial business. The company accepts and sends any message at the rates quoted, which can be delivered by telephone either in Chicago or Milwaukee. No arrangement has been made for the delivery of messages in any other way than by telephone, but they will be mailed to the persons for whom they are intended if they cannot be reached by telephone.

A new telegraph cable has been laid between England and Germany, reaching from Bacton in North Norfolk to Emden via Borkum, one of the Frisian Islands, making the third cable by this route. The cable is the property of an English company, but owing to the German government's having contributed to the cost of laying the same, the new German cable-laying steamer "Von Podbielski," belonging to the Norddeutsche See Kable Company, and which was described in the SCIENTIFIC AMERICAN SUPPLEMENT a few months ago, was chartered to undertake the work. Owing to the rough sea that was raging off the coast of Norfolk, it was found impossible to haul the heavy cable ashore in the usual manner by towing, so a warp was brought to land, and the cable itself floated to land by means of a number of huge red buoys. A body of one hundred men then hauled the cable along the trench to the small cable station. This task completed, the "Podbielski" set out for Emden, trailing the cable from her stern.

Engineering Notes.

At a recent meeting of the Paris Academy of Sciences M. Berthelot stated that he had found in a metallic box, covered with inscriptions and dated from 700 B. C., that a portion of one of its characters was made of an alloy of platinum.

The damage done by fire to a Russian shipyard at St. Petersburg was $5,000,000. The fire occurred at the Galley's Island shipyards. The cruiser "Wipjas" and other vessels were burned, as well as many government buildings and military warehouses.

The statue "La Parisienne," which surmounted the monumental entrance to the Paris Exposition, has come to an untimely end. It was being loaded for transport to Budapest when it was broken by a fall, so that only the head of the figure was left intact.

A large department store in Brooklyn has recently put in a cold storage plant for the protection of furs against moths. Usually the furs are sent to one of the large cold storage warehouses, but it is an innovation for dry goods establishments to have such a plant on their own premises.

The work of erecting the structure of the Boston Elevated Railway was completed on the 12th of May. The length of the road is seven miles, running from Sullivan Square by way of Main Street, Atlantic Avenue and Washington Street to a loop in Douglas Street.

Recent experiments with acetylene appear to indicate that much of the discomfort attending the combustion of unpurified gas, which was formerly ascribed to phosphureted hydrogen almost entirely, is really due in great measure to the presence of sulphur compounds other than sulphureted hydrogen, which compounds are not extracted from the gas by materials that are competent to remove H_2S.

A simple device has been put into practice in the U. S. for truing up railway carriage wheels, and it is said to have been attended with considerable success. It consists of a brake shoe, which is formed with pockets filled with a grinding material. When a wheel becomes flattened it is necessary only to remove the regular shoe and replace it with the truing shoe, run the carriage, do the braking as usual.

The railroad between Beirut and Damascus is sufficient for the traffic between the different towns along the route. Considering the heavy indebtedness of the road, together with the fact that the company must add nearly $100,000 each year to the running expenses, it is a question if it will be long-lived or not. Work on the Haifa-Hauran-Damascus Railroad has been stopped, and it does not look as if the present promoters would complete it.

Consul Hughes, of Coburg, April 26, 1901, says that, according to Russian official publications, the old wooden boat bridge over the Amu Davja, on the Middle Asiatic Railroad, near Tschardjni, will be replaced by an iron bridge 5,000 feet in length. The new structure, continues the Consul, is to be built in such a way as to prevent the river from shifting the bridge foundations. According to the plans published, there are to be twenty-four piers, each about 185 feet apart. The total weight of the structure will be about 5,190 tons, and, it is estimated, the cost will be about $2,558,500. The Consul suggests that this may be an opportunity for American bridge builders, if immediate action is taken.

The Bavarian State Railroad is establishing a preparatory school for employes at Munich. Attendance at this school for at least one term will be obligatory upon all who wish to obtain employment. Candidates who have passed the one-year army volunteer examination and who are desirous of competing for the higher executive in mechanical branches in the railroad service are allowed to have two months' practical experience in railroading before taking a course in the school, in order that they may be better able to understand the theoretical teaching which they will receive. Candidates are to be allowed partial pay while attending the school. This also includes the telegraphic course.

The handling of large crowds in parades and other gatherings is always a difficult matter. San Francisco has solved the problem of keeping the streets clear of crowds for parades without the usual cordon of police, and also without disturbing pavements by the insertion of poles in the pavement upon which to string wires. The device was recently illustrated and described in The Municipal Journal and Engineer. Metal sockets are sunk in the street pavement just outside the curbs and 50 feet apart. They are conical in shape. These sockets are embedded and surrounded by four inches of concrete. The socket is open at the bottom, permitting drainage. A cast-iron removable cap fits into the sockets when not in use. Into these sockets when parades are held are inserted wooden posts of Oregon pine; and the wire cable is attached to these posts.

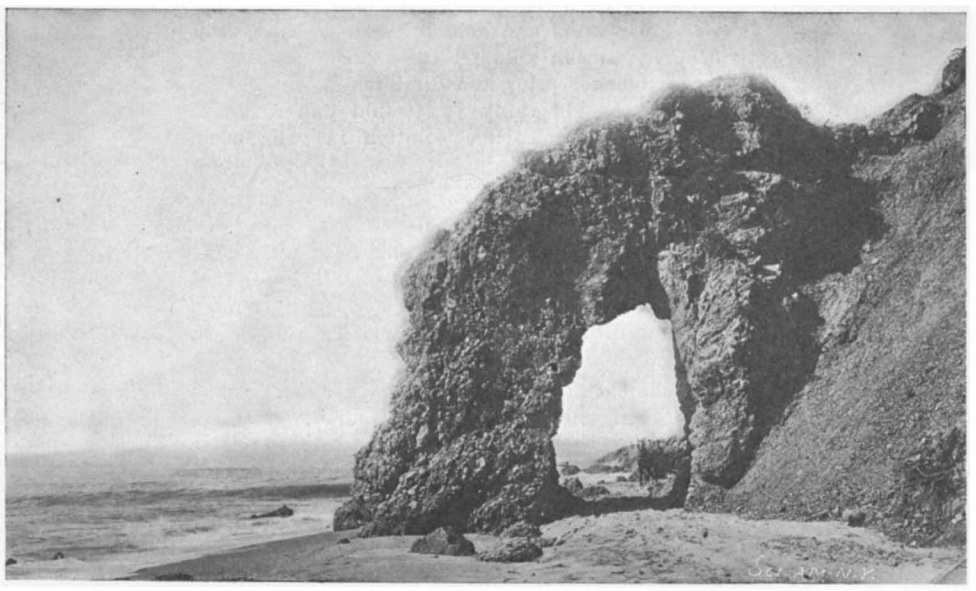
PYRAMIDS OF DEL MAR—EROSION ON THE PACIFIC COAST.

BY CHARLES F. HOLDER.

When one hears of the pyramids of Del Mar one naturally associates them with the pyramids of the Orient; but there are small pyramids, as those of Mexico, and the smallest pyramids, those of the coast of California along the township of Del Mar. These pyramids were not made by hands, but are none the less interesting, covering a large area of the precipitous cliff that fronts the sea. The pyramids are very small, and in reality are not pyramids at all, being, as shown in the accompanying illustration, a broken cliff made up of cone or pyramid-shaped points and presenting a striking appearance. Erosion has been the master hand here, the rush of water during the winter rains of decades, perhaps centuries. The cliff is a friable disintegrating sandstone, in some places with belts or areas of adobe, with here and there a statum of pebbles. The water in running down from the mesa above strikes a hard obstacle and divides, forming a channel on either side which increases in depth until a perfect cone or pyramid is formed. But it is the regularity with which this has been accomplished that gives the striking result. Looking down upon it the observer seems to see a field of mimic volcanoes, tens of thousands rising in points—a mimic picture of desolation in marked contrast to the mesa a few yards away gleaming with flowers, or the beach below with its peculiar and characteristic flora. From the beach, or front, shown in the illustration, the pyramids might be a gigantic pipe organ.

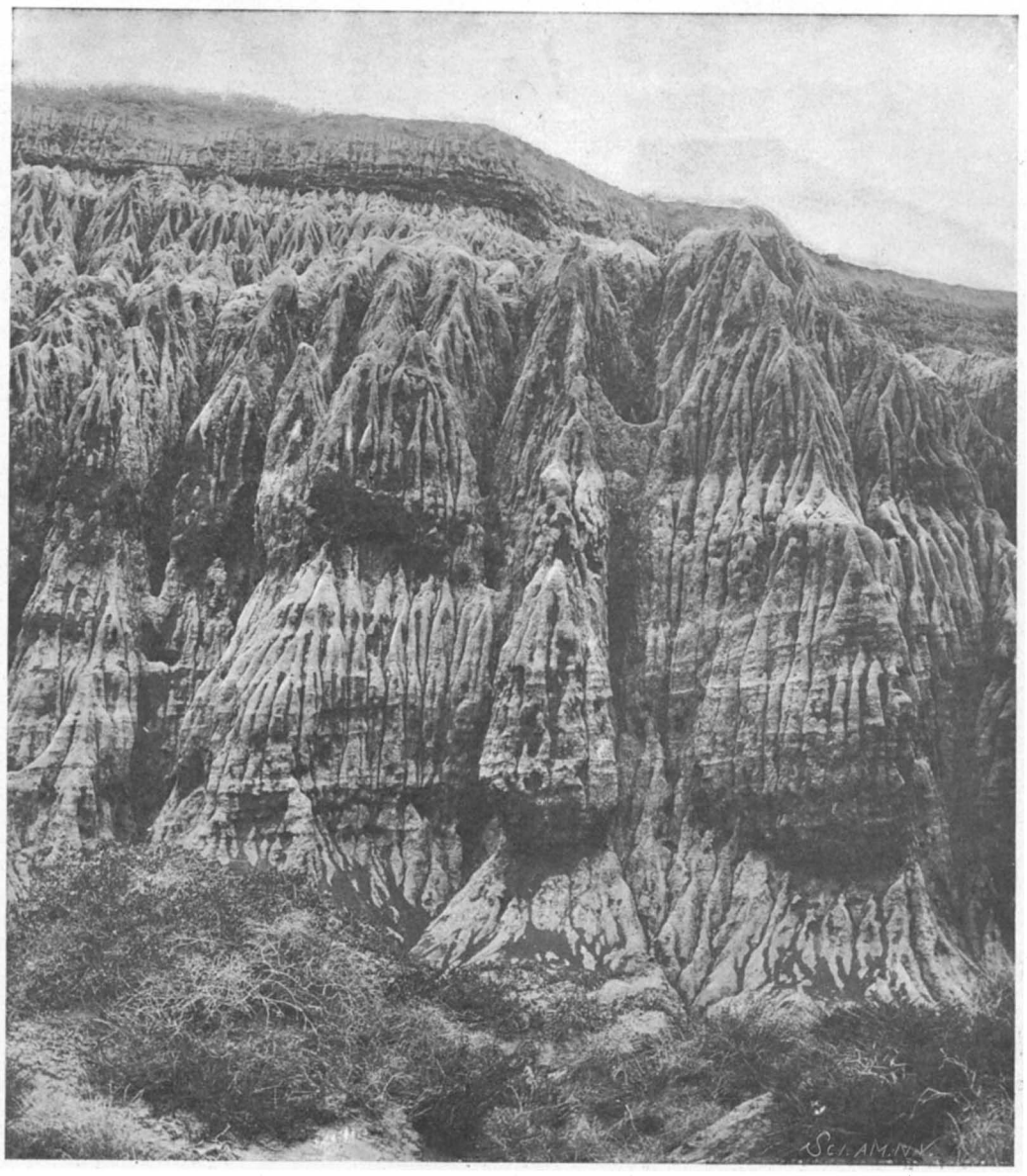
This formation, which adds materially to the attractiveness of the long stretch of coast of Southern California, is not confined to Del Mar, but is found at various points, though by no means in so marked a degree. The location indicated is well included among the points worthy a visit by the wanderer through the oasis of Southern California. The shore line is particularly interesting from the many singular, indeed striking, examples of erosion or water-wear that it affords. At Point Firman there is an interesting instance. Here a bluff reaches out into the sea, formed of stratified rock; by natural causes in the past the strata have been tipped to an angle of forty-five degrees; the front exposed to the spray has been beaten into strange saw-tooth shapes, and out from the shore a lofty pillar has for centuries defied the wear and tear of the elements. The sea has smoothed off the softer strata until in places a level, slightly inclined, smooth floor of rock is left from which runs a lofty tower composed of layers of different strata which for some reason have sufficient hardness to resist the rush and swirl of the waters. This point is one of the most exposed in Southern California, lying so that it receives the direct swell of the ocean to the north of the island of Santa Catalina, which is a natural windbreak for the coast for twenty miles south. Daily the sea boils about the rock sentinel, often covering it and striking the lofty cliff, rising in fluffy masses high in air to the top of the bluff where the light stands.

An interesting and picturesque effect of erosion expressive of the wear and tear of the sea is seen in the well-known Arch Rock at Santa Monica, about seventeen miles from Los Angeles. Here there is a long stretch of beach, the town being situated on a bluff which rises from thirty to fifty or more feet precipitously above it. At the north rise the Sierra Santa Monica Mountains, extending from ten miles inland to the very coast, terminating at the sea in the Arch Rock. The mountains here are a mass of conglomerate formed of water-worn pebbles, from the size of an egg to a man's head, firmly cemented in a solid mass. There is every evidence that this mountain range once extended farther out into the ocean, but the sea battered it down, leaving a pseudo flying buttress which is submerged at high tide. This point is exposed to heavy seas and, singularly enough, the wearing effect of the water told not upon the outer portion where the most force was vented, but upon the inner, with a result of breaking through it, forming a perfect arch about twenty-five feet high, which has now become one of the striking features of interest in this section of the coast, as beneath it runs the beach road from Santa Monica to the country beyond. At high tide the water covers the roadway here, and it is evident that the arch is growing and in time will be separated from the mountain and isolated.



ARCH ROCK, SANTA MONICA.

SENTINEL ROCK, POINT FIRMAN.



PYRAMID CLIFF, CALIFORNIA.

One of the most picturesque and remarkable examples of erosion was found by the writer at the island of Anacapa, off Ventura County. This island is the top of a submerged mountain range. In fact, at one time in all probability the coast of Southern California has had an outer coast range parallel to the mainland. When the land settled, as it must have done here in one of the many convulsions of the previous geological ages, the peaks of these mountains alone remained, now representing the islands of the Californian coast, beginning with San Miguel and terminating with the Catalina Islands and possibly the Coronados. Anacapa is the last of the Santa Barbara group. It is low-lying, made up of rock with a top dressing of soil, rising at the southern end in a sloping mesa about one hundred feet above the sea. The island has been broken through by the sea in one place, and at the extreme south end a section has been separated, forming an isolated arch of great size and beauty visible a long distance away. The arch is the softer portion broken away by the sea, and is large enough to admit the passage of a good-sized vessel. On the island to the north of this other arches are found illustrating this wear and tear of the sea, while at the island of Santa Catalina strange features are seen.

On this island the south and west coasts rise abrupt and forbidding, forming a wall often absolutely perpendicular, or even overhanging the sea, for miles there not being a beach or cove available at high water, the long rollers of the western ocean making a clear sweep upon it, rising high in the air. As a result, the coast is cut and worn in a marvelous manner, bringing out curious figures in the rock. At the north end a fine pedestal of rock surmounted by a natural figure is seen, the top ornamented with a turbanlike object which close observation shows to be an eagle's nest. Great fissures cut in here and there, narrow and deep, from which weird sounds of the seething and boiling sea issue. The base of the island has been worn into spouting caves, and as the sea rushes in the air is forced out, causing a deep, reverberating roar accompanied by a hissing sound like the escape of steam, while the water hurled upward and outward can be seen a long distance. On the south side of the island the water has worn an isolated rock into the image of a strange face, called the Sphinx, which looks into the west, not within the memory of man having changed.

THE THOMAS AUTO-TRICYCLE.

In Europe, where the motor-carriage industry was first developed and where the purchasing public is more expert in the use of motor-vehicles, the auto-tricycle plays no small part in automobilism. Fully seventy per cent of the self-propelled vehicles in Europe are of the three-wheeled type. American chauffeurs have not been blind to the merits of the tricycle. Each year sees a greater number of tricycles in use. Of the American-made auto-tricycles a typical example is a machine made by the E. R. Thomas Motor Company, of Buffalo, N. Y., which forms the subject of the accompanying illustration, and which compares favorably with the best French cycles.

In this vehicle the gasoline reservoir and carbureter are combined in a single triangularly-shaped tank, mounted behind the seat-post. The tank is provided with a tube, the lower end of which carries a flat plate called the deflector, held somewhat above the level of the gasoline. Through this tube and under the plate the atmospheric air passes and evaporates the gasoline which surrounds the edges of the plate. The vapors pass through the throttle and air-mixer valves on top of the carbureter, near the seat-post tube, and are here mixed with the proper quantity of air before entering the engine cylinder.

The crank-case of the engine contains two flywheels between which the crank turns. Besides performing its usual function the crank-pin also serves the purpose of holding the two flywheels together, sufficient space being allowed for the free passage of the crank. The left-hand side of the crank case contains the exhaust-cam mechanism. Fastened to the end of the left flywheel axle is a pinion which meshes with a small spur-gear, turned once for every two revolutions of the flywheel. Externally this gear is provided with a cam which acts upon a small shoe having a vertical stem whereby the exhaust poppet is lifted at the right moment.

The pinion performs still another function. Through its center a small shaft passes, terminating in a small cam whereby a spring is moved every second revolution, which spring in turn comes into contact with a platinum-pointed screw. The object of the vibrator thus constituted is to make and break the electric current so as to produce a spark in the combustion-chamber of the engine. Current for the production of the spark is obtained from a four-cell dry battery incased beneath the upper reach-tube. The insulated wires extend from the positive and negative poles through holes in the battery box, twice around the frame. The circuit can be made and broken by a grip on the handle-bar, by means of a key switch or safety switch at the front end of the tricycle, so that the machine cannot be started by any one but the operator. The switch is operated by a small brass plug-key which can be carried in the pocket.

The motor used is of the four-cycle type, the operation of which is too well known to require extended comment. The speed of the tricycle can be controlled either by means of the gas throttle lever on the left hand side of the upper horizontal bar, or by the spark-controller lever placed somewhat in advance of the gas lever on the left-hand side. This second lever moves the vibrator so that the moment of contact is varied as may be desired. When the spark passes early the explosive mixture is ignited at the moment of greatest compression. Hence a more powerful impulse of the piston, and hence greater speed is obtained. When ignition occurs late the piston has already started on its down-stroke and the compression is not at its maximum. Consequently, when the mixture is ignited the explosion is less powerful. When the throttle alone is used to control the speed, the quantity of gas fed to the motor is limited, so that the force of the explosion is reduced or increased at the rider's will.

The transmission gearing consists of a small pinion on the end of the right-hand axle of the flywheel, which pinion meshes with a larger spur-gear inclosed in an oil-tight aluminium case. The spur-gear is centrally secured to the differential-gear. Like the transmission-gearing the differential-gear is inclosed in a case. On the outside of this case is a brake-pulley and a hand-brake controlled from the handle-bar by a lever. The brake mechanism is so powerful that the machine can be stopped within its own length.

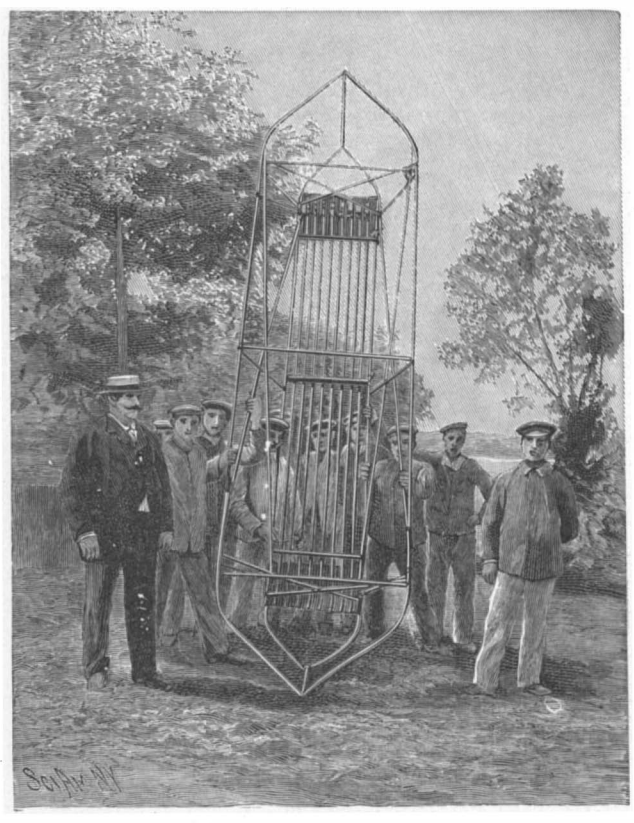
The exhaust-gases pass through a chamber or muffler placed beneath the rear cross-tube. By means of the muffler the noise of the exhausted gases is effectively dampened.

THE THOMAS AUTO-TRICYCLE.

A few drops of turpentine poured in closets will keep away moths.

THE LANCE-BOATS OF THE GERMAN CAVALRY.

It has always been a matter of no small difficulty to provide bodies of cavalry with suitable vessels for crossing streams. Only in cases of absolute necessity are the horses driven bodily into the water; for in the icy weather of winter and the torrid heat of summer the fording of a river is always accompanied with some danger. It has been the practice of the German War Department to equip each regiment of cavalry with two folding-boats, the value of which has always been rather questionable for the reason that the heavy boat-carrying wagons could follow the main body of men but slowly, and were often enough nowhere to be found when they were actually needed.



BOAT-FRAME OF LANCES AND CONNECTING-MEMBERS.

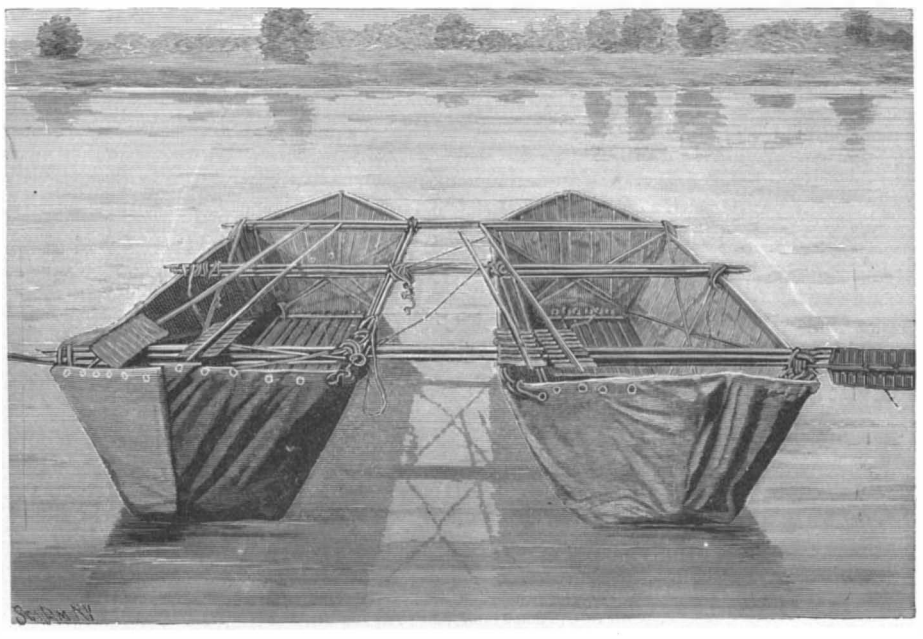
The cumbrous folding-boats and their wagons have now been discarded by the German army for a more trustworthy and more easily-carried vessel. The new contrivance is the invention of Herr Adolf Rey and is called a lance-boat for the reason that its frame is built up by means of the lances carried by German troopers. With twelve or sixteen lances six men can build a boat in five minutes; in two minutes they can take that boat apart. In two minutes the frame is spanned with a waterproof piece of canvas, and the boat is ready for service. Lances suitably covered with canvas are used as oars. The oar-blade consists of a strip of canvas 2 feet long and 6 inches broad, upon which slats are sewed. Such a rudder-blade can be readily rolled up and thrust into one's pocket.

The connecting members and locking devices used in assembling the boat-frame, together with the rudder-blades, weigh 20 kilograms (44 pounds); the canvas 12 kilograms (26 pounds); in all, 32 kilograms (72 pounds). By reason of this small weight a single horse can carry the parts of two boats.

The strategical value of the invention is obvious. As we have already remarked, every regiment of cavalry was formerly equipped with its wagon and two folding-boats. While the regiment was trotting along on a good road the wagon had no difficulty in keeping up. But horsemen had often enough to cut across country. It therefore happened that the large wagon, weighing some sixty hundredweight with the boat, could not always follow. Sometimes the wagon would stick fast in boggy soil or mud; sometimes it was upset. Thus it happened that for days, as a general rule, no one in a regiment knew exactly where the boat wagon might be found; and thus it happened that the boats were never at hand when they were most urgently needed. It was practically impossible not only to traverse marshy meadows, but also to cross deep or broad ditches or to follow the small winding paths of a forest. With a horse, on the contrary, carrying the part of two boats, these difficulties disappear. In the quiet, concealed groves which could never be reached with a wagon, a lance-boat can be assembled in a few minutes. The patrols can cross the river at a spot which the enemy would probably consider it impossible for any body of cavalry to ford. Equipped with such boats a mobile squadron thrown into an enemy's country is hampered by nothing. Impassable roads and bridges, which are usually destroyed or rendered impassable by the enemy, can no longer hinder the onward course of the troop.

As we have already remarked, each regiment of German cavalry has been hitherto equipped with one wagon and two folding-boats. The wagon is drawn by six horses, three men acting as drivers, and one officer as a commander. Four men and seven horses are therefore required. The adoption of the lance-boat will dispense with all this unnecessary apparatus. A single horse will now carry the parts of two lance-boats for each squadron. If two folding-boats of the old pattern were to be provided for each squadron, a regiment composed of five squadrons would require the services of twenty men and thirty-five horses. The German cavalry is divided into one hundred regiments. Hence two thousand men and three thousand five hundred horses would be needed to carry along folding-boats. The enormous saving of the lance-boats is therefore evident.

Very quietly experiments have been made with the lance-boats for the past two years. Their success has been such that their adoption has been definitely decided upon. We are indebted to Ueber Land und Meer for the above description.



TWO LANCE-BOATS READY FOR SERVICE.

The Comptroller-General of Patents, Designs, and Trade Marks for Great Britain has issued his report for the year 1900. There were altogether 23,922 applications for patents last year, 16,952 for the registry of designs, and 7,937 for trade marks. There was a marked decrease in the applications for patents from the United Kingdom, while the number of applications from this country showed a great increase. Outside of Great Britain there were 3,184 applications from the United States, 2,651 from Germany, 946 from France, 418 from Austria, 184 from Belgium, 156 from Canada, 150 from Switzerland, 104 from Sweden, and 100 from Italy. No other country contributed as many as 100. The revenue derived from fees for patents amounted to $1,020,720, an increase upon the returns for 1899.

The Jungfrau Electric Railroad.

In a paper read at the International Congress of Railroads, Paris, Messrs. Auvert and Mazen gave some interesting details regarding the Jungfrau Electric Railroad, from which we select the following facts: The construction of this road was begun at the end of 1896, after several years of study, this having been necessary owing to the importance and difficulty of the work to be executed. The line will unite the Bernese Oberland railroad system with the station of Petite Scheidegg, situated on a rocky plateau about 200 feet below the summit of the Jungfrau. An electric elevator will take the passengers from the plateau to the summit of the mountain. The distance between the terminal stations of the road is about 7½ miles and the maximum grade is 25 per cent. After a stretch of 1½ miles in the open air, the line runs in a tunnel for nearly 6 miles. The track is narrow-gage (39 inches) and is laid on iron ties; a rack and pinion system is used on account of the heavy grade, the rack being of the Strub pattern and laid between the rails; the curves have a radius of 325 feet in the open road and 650 feet in the tunnel. After an international concourse which was held in order to make a thorough study of the system, the commission appointed for the purpose decided to adopt electric traction, using the three-phase system of alternating current. The energy necessary for the trains as well as for the electric elevator and different installations is to be furnished by hydraulic plants at Lauterbrunnen and Busglauenen, using the power of the Rutschine; at the first point 2,200 horse power may be obtained, and at the second, 9,000 horse power. The first hydraulic plant was installed at Lauterbrunnen. It consists of four alternators of the Oerlikon type connected by elastic coupling to Girard turbines with horizontal shaft.

The overhead line which carries the current from Lauterbrunnen to Petite Scheidegg at 7,000 volts is of hard-drawn copper, carried on porcelain insulators. The line is fed by 12 sub-stations distributed at intervals which depend upon the grade of the road; the last sub-station supplies the electric elevator. At the sub-stations the voltage is lowered by transformers from 7,000 to 500 volts for the line; each of these stations has two Oerlikon transformers of 200 kilowatts capacity. The rolling stock of the system consists of electric locomotives, a type of passenger car with single truck and connected to the locomotive at the opposite point, ordinary cars with two axles, and freight cars. The locomotives, of which the first were built by the Swiss Company of Winterthur, and the electrical equipment furnished by Brown, Boveri & Co., have two axles and carry two tri-phase motors of 150 horse power each, working at 800 revolutions. Each of the motors operates a toothed pinion engaging in the rack. The cabins of the locomotives are entirely inclosed, owing to the low temperature which prevails at times in these regions. The locomotives carry two trolleys for each of the two overhead wires. The system of brakes has been made the object of special study, owing to the heavy grades; five different methods of braking are used. In the first, the rotating magnetic field of the motor is reversed in direction, causing the armature to stop and then rotate in the opposite direction; in the second the armature is simply put in short circuit, and as the train descends by its own weight the motors become generators and a braking action ensues. A third disposition applies a brake when the current is interrupted; this brake is formed of a steel band passing around a drum mounted on the axle of each motor and is applied by a system of powerful springs. These springs are normally held back by an iron core which plunges into a solenoid connected to the circuit of the line; a centrifugal regulator cuts the current when the speed of the locomotive passes a fixed limit, and the brake is applied; the current may be also broken by a switch when necessary. Lastly, a brake screw and levers act upon brake shoes working against a drum mounted on the shafts of the pinions and a clutch brake acts upon the rack. The passenger cars are entirely inclosed and are electrically lighted and heated. The freight cars are open and weigh when loaded about 11 tons. The elevator which is designed to convey the tourists from the plateau to the summit of the mountain is to be operated by a three-phase motor mounted directly with the cabin; this motor operates two pinions, each of which engages with a rack fixed to the sides of the elevator shaft, thus lifting the elevator; besides, two other racks will be run over by pinions which operate the automatic speed regulators. The mechanical installation of the elevators will be contained upon a platform placed underneath the cabin. The tunnel will be lighted by incandescent lamps placed at 80-foot intervals; the stations will be well lighted and heated by electric radiators taking 1½ horse power each.

The aggregate tonnage of American vessels is 5,164,839 tons, and the vessels having a tonnage of 1,565,587 navigate the Great Lakes. The aggregate tonnage ten years ago, or in 1891, was 4,684,759.

A NEW INSTRUMENT FOR THE MEASUREMENT OF HIGH TEMPERATURES.*

Up to a comparatively recent date, there had not been invented an instrument which would permit of measuring with facility and in a continuous manner temperatures of 1,000° F. and over. Among the systems in use may be mentioned the air thermometer, thermo-electric couple, the electric method with platinum resistance coil, fusible alloys, and other methods, but none of these is suitable for ordinary and continuous service. They lack the element of continuity; the apparatus are too delicate for ordinary use, they are inexact, or, on the other hand, lack the qualities necessary to assure a regular and easy manipulation. The system which is to be described has been tried for several months, and seems to be eminently fitted for measuring and registering temperatures up to the point at which platinum softens. Its principle of working is shown in the first diagram. *A* and *B* are openings made in platinum diaphragms at each end

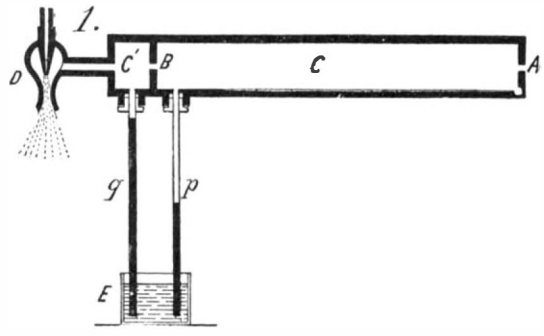


Fig. 1.—NEW PYROMETER.

of a chamber, *C*; at *D* is a steam aspirator which maintains a uniform exhaust in the chamber, *C'*, on the left of the diaphragm. Air is drawn through the diaphragm by the aspiration in *C'* and a partial vacuum is formed in the chamber, *C*, which causes air to enter it through the opening, *A*. The equilibrium is established in a few seconds, and the vacua in *C* and *C'* are measured by the water-gages, *p* and *q*. If the air arriving at *A* is kept hot, while the temperature of *B* and the vacuum in *C'* remain constant, the vacuum in *C* will be increased, and the temperature of the ingoing air will be measured by the height of the water in the gage, *p*. The apparatus constructed upon this principle is shown in the second diagram. At *B* is the aspirator, which keeps a constant vacuum

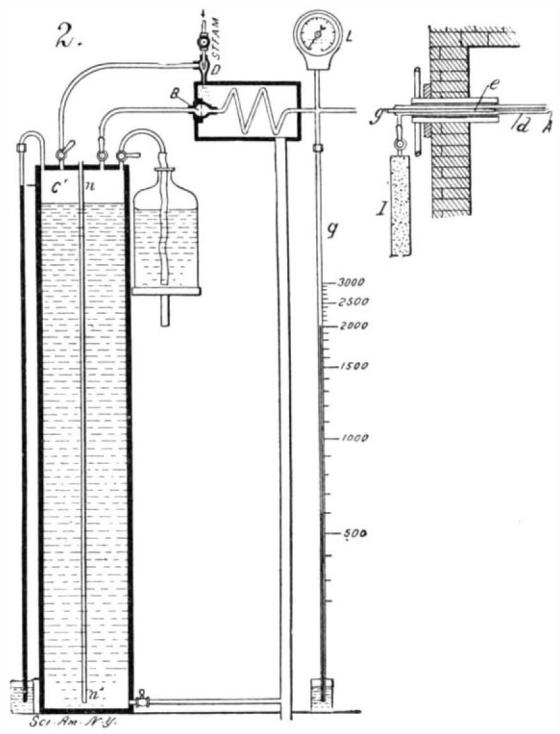


Fig. 2.—NEW PYROMETER.

in the chamber, *C'*, partly filled with water and in which plunges the tube, *n n'*. If the vacuum is greater than the water pressure, this will allow air to enter through the tube and the vacuum will be diminished. In practice a small quantity of air always passes in the tube and the vacuum is kept constant. To maintain a constant temperature of the diaphragm, *B*, the latter, as well as a portion of the air-inlet tube, is inclosed in a recipient traversed by the steam coming from the aspirator. The air arrives slowly enough to take the temperature of the steam before reaching the opening, *B*. The vacuum is measured by the water gage, *q*, and the registering vacuum gage, *L*, above. On the right of the diagram is the disposition of the apparatus in the furnace. The entering air passes first through a tube, *I*, filled with cotton, then into the platinum tube, *d*, inside the furnace, where it takes the temperature of the surrounding medium. Inside of it is a second tube, *e*, which has an opening, *A*, by which the air enters; this is connected at *g* to a copper tube leading to the apparatus on the left. The instrument is graduated by comparing it directly with a standard pyrometer, as its practical curve differs considerably from that calculated by the formula. A number of trials lasting for several months have shown that the graduation is sufficiently exact, that the indications do not vary and that the temperature at *A* is always measured by the pressure of the gage. The instrument is not appreciably affected by a change of barometric pressure, as this produces effects which tend to counterbalance each other. The advantage of an instrument which will measure high temperatures need not be insisted upon. At present, in the case of a battery of gas furnaces or water gas apparatus, the proper temperature is decided upon after experimenting for a certain time, and the men in charge are instructed to work to these points. It is impossible, however, to keep a constant heat in this manner, and it is important to have an instrument which will assure a regular working. An efficient pyrometer will undoubtedly prove of great value in many industries in which high temperatures are used.

* Extract by Paris Correspondent of Scientific American from a paper read before the International Congress of Gas Industries by Mr. Alten S. Miller, of New York.

Report of the International Hydrographic Congress.

The full report of the International Hydrographic Congress, which met at Christiania a short time ago, is now published, and it only now awaits the support of the various governments before the recommendations of the Congress are carried out. It is suggested that the explorations of the Northern Atlantic should be carried on for at least five years, and that each nation should be assigned a certain area of the ocean to study thoroughly. The conference also suggested the establishment of a permanent Hydrographic Council for the co-operative hydrographic and biological investigation of the waters, with a central bureau and international laboratory. It is estimated that the cost of maintaining this central establishment would only amount to about $25,000 annually, so that the contribution of each government would be trifling. The Congress also strongly recommended the inclusion of Iceland and the Faröe Islands in the European telegraph system as soon as possible in order to facilitate and to render more thorough the weather forecasts for long periods, and also for the purposes of the deep sea fisheries.

Preserve Your Papers.

Each issue of the Scientific American should be preserved, after having been read, by securing the same in a neat and attractive binder, which is supplied by the publishers. It will prevent papers from being mislaid, and at the end of the half year the numbers will be in perfect order to send to a book-binder, and all of the numbers of six months will be available for reference at any time. Binders for both the Scientific American and Scientific American Supplement are provided. They are covered with cloth and the names of the periodicals are stamped in gilt on the sides. One binder will last many years, and if the subscriber does not wish to bind the numbers permanently, he can fasten them together by cord through the holes which have been punched after removing from the binder. This affords an inexpensive and satisfactory way of keeping volumes that are not to be referred to frequently. The binder for either publication is mailed on receipt of $1.50.

The Current Supplement.

The current Supplement, No. 1331, has many articles of unusual interest. "The Excavations of Timgad" is accompanied by several illustrations showing the important archæological discoveries which have recently been made. "Protection of Ferric Structures" by M. P. Wood is concluded in this issue. "A Remarkable Railway Crossing" shows a point where 1,135 trains pass daily at Newcastle, England. "Progress of Photography" by George G. Rockwood is concluded. The present installment deals with the reproductions of paintings, photographs in natural colors, instantaneous photography, photography for war purposes, photography as legal evidence, etc. "Electrolysis of Water in Gas Pipes" is by W. W. Brigden. "Milk Contamination and How Best to Prevent It" is by Dr. D. S. Hanson.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

HOEING-MACHINE.—GEORGE W. STACY, Belmont, Miss. The invention is an improvement in machines designed for chopping cotton or for use wherever it is desired to hoe the ground or thin out a growing crop. The improvements are designed to be used in connection with any form of straddle-row cultivator and to be operated from the wheels of the cultivator.

BERRY-BOX.—HENRY C. FINLEY, 135 Main Street, Oklahoma, Oklahoma Territory. The inventor has devised an improved berry-box made of pasteboard or other thin, cheap material, which box can be packed and shipped "knocked down" or in the flat and easily and quickly struck up for use. The box is composed of two parts, a body and a bottom, the latter being supported centrally by the fastening device which secures the side of the bodies together.

Engineering Improvements.

ROTARY ENGINE.—EDWARD A. STEWART, Troy, Ohio. The piston of the engine is provided with a number of peripheral buckets. Around the cylinder a number of steam-chests are grouped, each being connected by an admission-port and an exhaust-port with the cylinder. A valve is mounted to turn in each steam-chest to control the admission and exhaust of the steam to and from the cylinder and the buckets of the piston. These valves are so arranged that one of the buckets is always under continuous pressure of steam from an admission-port. The steam can be used expansively in high or low-pressure cylinders.

TABLE FOR CUTTING CLAY FENCE-POSTS, ETC.—ARPHAD SNELL, Tice, Ill. In the SCIENTIFIC AMERICAN for January 7, 1899, an illustrated article appeared on a clay-cutting table invented by Mr. Snell. The purpose of the present invention is to simplify the general construction of that table. A fixed and a rotary conveyor-table are mounted upon the same carriage. Mechanism is provided to move the carriage to and from the mold or shaping machine, limiting the movement of the carriage at such time. The rotary conveyor-table can be turned by a simple mechanism and temporarily locked in the desired position. The table is provided with a series of belts upon which the molded article is received. Fingers, operating simultaneously with the cutting mechanism, serve to make depressions in a molded fence-post at desired intervals apart. The depressions thus formed are intended to receive fence-wires.

METHOD OF SHRINKING AND FINISHING LINENS, COTTONS OR OTHER FABRICS.—WILLIAM HEBDON, Brooklyn, New York city. The method consists in saturating a piece of cloth, then subjecting it to pressure to squeeze out surplus moisture. The wet piece is rolled in a dry piece to moisten the latter. Both pieces are then heated and dried in open width and finally pressed in open width. In order to carry out this process an apparatus is employed which is described in the patent.

WAVE-POWER.—ISAAC A. BRADDOCK, Haddonfield, N. J. The invention is an improvement in machines actuated by incoming or outgoing waves to compress and store air to be used in driving machinery. A hollow float is pivoted to an anchor. On the shore, a cylinder is mounted, the piston of which is connected with the float. A pipe connection extends between the cylinder and the float. The float is likewise connected by a pipe with a storage vessel for air. By reason of this arrangement the cylinders move toward and from the water to accommodate the device to the rise and fall of the tides and to storms and calms which influence the height of the water.

SWITCH-LOCKING DEVICE.—WALTER E. EMERY, West Chicago, Ill. A bracket is attached to the switch-point, and to a switch-rod which passes under the main rail. An arm is carried by the main rail and a lock is sustained on the arm. By these means the switch is securely held in either open or closed position.

Miscellaneous Inventions.

HORSE-HITCHING DEVICE.—IDA W. and HENRY CASSER, Colorado Springs, Colo. The device is to be attached to a vehicle and is so connected with the bridle-bit that, should the horse start forward, the bit connection will be wound in such a manner as to draw the horse's head down or back and stop him. Thus the usual hitching posts, weights or the like are dispensed with.

METAL PRINTING-WHEEL.—EDWARD FUCHS, Manhattan, New York city. The invention relates to printing telegraph and other machines using a printing-wheel for printing type-characters on tape, paper sheets and the like. This new wheel is cheap in construction and is arranged to permit convenient renewal of worn or injured type-characters on the body of the wheel.

DRYING DEVICE FOR CEMENT-KILNS.—HARRY STEHMANN, Hoboken, N. J. It is one of the functions of this invention to utilize the waste gases to dry the material before it is admitted into the kiln. A draft is produced in the kiln in such a manner as to obtain a product of superior quality at a relatively small cost, and to keep the kiln in a working condition so that few repairs will be necessary.

GAME-TABLE.—CHARLES W. STROUD, Joplin, Mo. The table is to be used in card-games. The essential feature is a table having rotary parts or carriers provided with pockets to receive the cards which are to be dealt to the players. By means of this device a fair distribution is secured. There are fifty-four pockets in all. Hence it will be necessary to take two cards from another pack, a deuce and a tray, for example, and give them a certain value such as honors. When the pockets on the carriers are alined, there will be nine slots in front of each player. From the slots, the five cards of a hand are selected. Should the player wish to discard, he lays his discards to one side and takes other cards from the remaining series of four pockets. Other methods of drawing the cards can be employed. The table is a simple and very efficient and fair card-dealer.

TIMBER-HOOK.—GEORGE H. HITCHINGS, Hoquiam, Wash. The drag device carries a joint-plate which is pivotally connected by straps with the hook-bars. The drag device when drawn upon pulls the joint-plate which operates to draw the hook-bars firmly together and force their prongs into the timber. The drag device swings freely from side to side, independently of the hook-bars, and being connected with the joint-plate pulls thereon and then on the connecting straps. Thus traction is exerted whether the drag device is in line with the joint or hook-bars or stands on either side of the joint, as most frequently happens. All twisting at the joints is avoided. The parts of the hooks are maintained and braced in the desired positions.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

DOMESTIC SERVICE. By Lucy Maynard Salmon. New York: The Macmillan Company. 1901. 338 pp. Price $2.

This most helpful book on the "servant question" was written after a thorough scientific investigation of the problem by Miss Salmon. Five thousand blanks containing pertinent questions were sent out to employers and employees throughout the country; and the statistics found in the book were compiled from the returns. The deductions and conclusions therefrom are found in several interesting chapters. A chapter throwing much light on domestic service abroad has been added to this, the second edition.

THE THEORY OF NUMBERS. By Richard Dedekind. Translated from the German by Prof. W. W. Beman. Chicago: The Open Court Publishing Company. 1901. 115 pp. Price 75 cents.

Two interesting essays on Continuity and Irrational Numbers and The Nature and Meaning of Numbers, respectively, are contained in this little book. The essays contain much stimulating thought, and are well worth the perusal of all who are interested in higher mathematics.

THE TINSMITH'S PATTERN MANUAL. By Joe K. Little, C.E. Chicago: The American Artisan Press. 1901. 248 pp., 100 diagrams. Price $3.50.

This book will be found of incalculable value to tinners and all sheet metal workers. In it are laid down general geometrical principles which, when mastered, will enable the user to draw a number of different patterns whose construction is essentially the same; and to develop the surface of any article with much greater ease and rapidity than by following the methods in general use. The book is entirely practical, and its popularity is shown by the fact that a second edition, brought thoroughly up to date, has just been issued.

THE STANDARD GUIDE TO THE CITY OF MEXICO. By Robert S. Barrett. City of Mexico: Modern Mexico Publishing Company. 1901. 152 pp. Price 50 cents.

This guide will be found invaluable to Americans about to visit Mexico. It furnishes a complete description of the city and its environs, and is copiously illustrated with fine half-tone engravings. It is prefaced by an interesting historical note, and all the buildings are described with full notice of their historical interest.

ROAD MAKING AND MAINTENANCE. A Practical Treatise for Engineers, Surveyors and Others. With an Historical Sketch of Ancient and Modern Practice. By Thomas Aitken. With Numerous Plates and Illustrations. London: Charles Griffen & Company, Limited. Philadelphia: J. B. Lippincott Company. 1900. Pp. 440. Price $6.

The author describes the modern methods at present employed in England, which make use of all the recently developed road-making machinery. The book is comprehensive, and treats of the subject in detail from the quarrying of road material or metal to the completion and keeping in repair of the road. The cost of the various operations based on actual road-building experience is given also. The latter half of the book is devoted to the description of carriageways and footpaths and the materials employed in their construction. Some novel suggestions for relieving overcrowding of the traffic in large cities are also given. The book is a valuable one for all persons engaged or interested in improving the roads of our country.

BERICHT DES COMITÉS DER MECHANISCHEN KUENSTE UEBER DIE ARBEITEN DES HERRN ALBERT COLLET. Die Sicherung der Schienenbefestigungen betreffend, Abgefasst von Herrn E. Sauvage. Paris, Rue de Rennes 14.

BERICHT UEBER DIE SICHERUNG UND BEFESTIGUNG DER SCHIENEN AUF HOLZWELLEN VERMITTELST EINSCHRAUBBARER HOLZDUEBEL (trénail). System Albert Collet. Von M. Cartault. Paris: Veuve Ch. Dunod.

DIE EISENKONSTRUKTIONEN DER INGENIEUR-HOCHBAUTEN. Ein Lehrbuch zum Gebrauche an technischen Hochschulen und in der Praxis. Von Max Foerster. IV. Lieferung. Fortsetzung des III. Abschnittes. Kuppeldächer, Zeltdächer, Walmdächer, und Föpplsche Tonnenflechtwerkdächer. 97 illustrations and one plate. Leipzig: Wilhelm Engelman. 1901. Large octavo. Pp. 257-320.

The fourth instalment of this admirable work, which we have had previously occasion to comment upon favorably, continues the discussion of roofs begun in the previous instalment. The explanations and illustrations are singularly clear. Excellent use has been made of the graphic system of estimating strains in framed structures.

KNOWLEDGE DIARY AND SCIENTIFIC HANDBOOK FOR 1901. London: Knowledge Office. 1900. 8vo. Pp. 528. Price, $1.20.

The volume will prove a most useful adjunct to the libraries of all astronomical workers, as it contains a historical summary of the advance of that science in the nineteenth century, with astronomical notes and tables and an account of the astronomical phenomena of the year, and twelve star maps showing the night sky for every night in the year, with full descriptive account of the constellations and principal stars, together with a calendar of notable events, table of principal observatories in the world and monthly astro-ephemeris. The pages devoted to the Diary, which form the bulk of the book, are of large size, and a page is provided for each day. While the scope of the work is mainly astronomical, its usefulness is not confined entirely to that science, and the diary alone is worth the moderate price asked for the entire book.

TEXTBOOK OF IMPORTANT MINERALS AND ROCKS WITH TABLES FOR THE DETERMINATION OF MINERALS. By S. E. Tillman. New York: John Wiley & Sons. 1900. 8vo. Pp. 176. Price $2.

This book is the slow outgrowth of the efforts to meet the necessities of the United States Military Academy for a convenient textbook of important minerals and rocks. The author has performed a great task in a very acceptable manner. The tables are excellent and tend to afford a ready determination of the rocks.

THE RUSSIAN JOURNAL OF FINANCIAL STATISTICS. February, 1901. St. Petersburg: The Russian Journal, 23 Millionnai. 8vo. Pp. 740. Price $5 per annum.

This is a very extraordinary publication. The publishers state that copies of two specimen numbers will be mailed on receipt of postal expense. The portly volume is brimful of information relating to Russia. It seems to be a careful compilation, and will undoubtedly be welcomed by all those who have any trade with Russia.

THE OCTOPUS. A Story of California. By Frank Norris. New York: Doubleday, Page & Co. 1901. 12mo. Pp. 652. Price $1.50.

This novel deals with the wheat growers of San Joaquin Valley, who came into actual conflict with the railroad, which they believe is trying to defraud them of their lands. It is the first volume of a trilogy entitled "The Epic of the Wheat." The first book deals with the war between the wheat grower and the railroad trusts; the second, "The Pit," will be the fictitious narrative of a "deal" in the Chicago wheat pit; the third, "The Wolf," will probably have for its pivotal episode the relieving of a famine in an old world community. Among the interesting features of the present novel are a map of the locality and a list of the principal characters in it. With the modern psychological work of fiction this last innovation is especially commended.

ELEMENTARY TEXTBOOK OF COAL MINING. By Robert Peel. London: Blackie & Son. Philadelphia and New York: J. B. Lippincott Company. 1901. 16mo. Pp. 300. Price $1.

This book is intended mainly as a textbook for those who are first-year elementary students of coal mining, attending classes in connection with the Science and Art Department, or the lectures which are now given at most mining centers in England under the technical education scheme. This, of course, greatly curtails its usefulness for American readers. Fortunately we have nothing like the Science and Art Department in this country to hamper our students. To those who wish a general knowledge of coal mining the book will perhaps prove of value.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 945.—For manufacturers of small gasoline or petroleum motors suitable for automobiles.

TURBINES.—Leffel & Co. Springfield, Ohio, U. S. A.

Inquiry No. 946.—For a foot lathe suitable for amateur's use.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 947.—For manufacturers of hard rubber.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 948.—For manufacturers of glass tubes.

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 949.—For toy novelties such as a wheel of fortune, etc.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 950.—For manufacturers of large job presses.

Sheet Metal Stamping: difficult forms a specialty. The Crosby Company, Buffalo, N. Y.

Inquiry No. 951.—For manufacturers of tampico or fiber.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 952.—For dealers in small brass wire for making brushes.

For Sheet Brass Stamping and small Castings, write Badger Brass Mfg. Co., Kenosha, Wis.

Inquiry No. 953.—For the manufacturers of a patent knife and fork combined.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 954.—For manufacturers of dredge boats.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 955.—For manufacturers of ditching machines.

SAWMILLS.—With variable friction feed. Send for Catalogue B. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 956.—For parties to manufacture a fly screen attachment of 20 gage sheet galvanized iron and of special dimensions.

We are equipped to manufacture all kinds of specialties. Send samples. Chicago Handle Bar Co. Chicago Ill.

Inquiry No. 957.—For manufacturers of light novelties and goods suitable for the mail order business.

Kester Electric Mf'g Co's, Self-fluxing solder saves labor, strong non-corrosive joints, without acid, Chicago, Ill.

Inquiry No. 958.—For dealers in synthol.

Manufacturers of Valves, Fittings, Brass and Iron Work. Spindler & Deringer, 18-22 Morris St., Jersey City, N. J.

Inquiry No. 959.—For manufacturers of machinery for turning all kinds of handles, spokes, bobbins, etc.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 960.—For a combined planer to plane lumber and make mouldings.

See our Collective Exhibit—Section "S," Electricity Building, Pan American Exposition. Standard Welding Company, Cleveland, Ohio.

Inquiry No. 961.—For machinery for operating a cold storage plant.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 962.—For parties with experience in locating and boring oil wells.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 963.—For manufacturers of German silver.

Will handle small patented novelties, wood or iron, or copyrighted business forms. S. A. P. O. Box 568, Cincinnati, Ohio.

Inquiry No. 964.—For a machine for braiding wooden slats into wire; the machine to be run by a power engine.

Will give a one-half interest in twelve inventions, or any part of number, for money to perfect patent and dispose of same. Address S. O. Stewart, E. Las Vegas, New Mexico.

Inquiry No. 965.—For manufacturers of models of steam engines from ⅛ to 1 h. p.

WANTED FACTORIES.—Good factory sites at Brookport, Ill., on Ohio River, just below mouth of Tennessee and Cumberland Rivers; 3,000 miles of navigable rivers above us with good timber for factory purposes. Railroad and river transportation good. Elisha Baugh, Mayor Brookport, Ill.

Inquiry No. 966.—For machinery for making or cutting pearl buttons.

ELECTRICAL ENGINEER (Tramways).—Wanted immediately by the Council of the City of Wellington, New Zealand, a thoroughly qualified Electrical Engineer, who must have had special experience in carrying out and equipping overhead electrical tramways and power stations. Full particulars and conditions may be obtained on application to Messrs. R. W. Forbes & Son, Produce Exchange, New York, and applications must be delivered at the office of Messrs. John Duthie & Co., Ltd., Lime Street, London, E. C., England, not later than noon on the 20th July.

Inquiry No. 967.—For the designer and builder of automatic machinery for the manufacture of the mechanical parts of a self-sharpening lead pencil.

☞ Send for new and complete catalogue of Scientific and other Books for sale by Munn & Co., 361 Broadway, New York. Free on application.

Inquiry No. 968.—For machinery and equipment consisting of some device for drying blocks 3 feet long by 12 inches wide by 2 inches thick made of a composition of plaster and fibrous ingredients. Blocks contain from 50 per cent to 60 per cent of water, various systems of hot air from steam pipes having been used in the way of tunnels, rooms, etc.

Inquiry No. 969.—For a small pumping plant for household purposes, having, if possible, power available for operating a small lathe or other machinery occasionally.

Inquiry No. 970.—For parties to manufacture an all-metal vehicle wheel,

Inquiry No. 971.— For manufacturers of wheels used in small glass cutters.

Inquiry No. 972.—For manufacturers of tubular leather punches, as used by harness makers.

Inquiry No. 973.—For manufacturers of aluminium coated metal.

Inquiry No. 974.—For manufacturers of a flexible metal hose for steam or compressed air.

Inquiry No. 975.—For manufacturers of lathes or machines for turning special forms of shoe lasts.

Inquiry No. 976.—For parties making a novelty for photographers' use that can be sent through the mail, and selling for $1 or less.

Inquiry No. 977.—For manufacturers of tapered aluminium tubing.

Inquiry No. 978.—Wanted the name and address of a manufacturer of water motors; answer stating different sizes made.

Inquiry No. 979.—Wanted the name and address of a manufacturer of a successful cow milking machine.

Inquiry No. 980.—Wanted the name and address of a manufacturer of machinery for shaving off the bark on a special foreign tree (name not given).

Inquiry No. 981.—For manufacturers of monuments other than stone.

Inquiry No. 982.—For manufacturers of appliances for light mining, such as gold pans, portable smelters, etc.

Inquiry No. 983.—For manufacturers of cheap efficient writing duplicators.

Inquiry No. 984.—For manufacturers of coffee roasters and mills,

Inquiry No. 985.—For manufacturers of hoisting machinery and tools suitable for building purposes.

Inquiry No. 986.—For manufacturers of steel riveted masts for vessels.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8233) F. H. B. writes: Please explain what metals, minerals or ores draw lightning the most. We have a piece of about 20 acres on which lightning always strikes during a thunder shower. Land slopes to the west with higher land farther east, on which lightning seldom strikes, that is, comparatively seldom. Rock near surface, sometimes cropping out, of a light gray color, looks like bastard slate, but will seldom split. Land covered with young timber, hemlock, pine, white oak, red oak, maple and hickory. I think full 90 per cent of the hemlocks have been struck by lightning, while a large per cent of the other trees have also been struck. Out of 116 hemlocks which measured 6 inches 20 feet above the ground, 112 showed lightning marks. Near one end of the tract is a depression, at the bottom of which almost every tree has been struck by lightning. Live stock and game shun the tract, but not the land around it. The surface rock overlies a soft slate, which, judging from the dip, must be 300 feet below the surface. Near the upper edge of the slate is a spring, where, when the water is low, an oil collects, which, when collected on a woolen cloth, burns. I have never been able to collect enough to send you for a test, as it flows off with the water, and being transparent, is hard to find. Only when the spring is so low that no water runs away have I collected it on woolen cloth. A. Such instances are difficult to discuss. Many such have been reported, but the officers of the Weather Bureau are thought to be of the opinion that one sort of a tree is no more likely to be struck by lightning than another. We do not think any ores or metals under the ground would *draw* the lightning any more readily than water would do it. Nor would the mineral oil seem to account for the phenomena. The proportion of hemlocks marred by the lightning is certainly very large.

(8234) M. E. P. asks: 1. I am operating a single-phase light plant with about 800 lights. My transformer and liner are nearly all overloaded. Could I raise the voltage from 1,000 to 2,000 volts and use 200-volt lamps in place of 100-volt, or would it be better to parallel the secondary coils in the transformer and still run 100-volt lamps and change the generator to 2,000 volts? A. An additional generator to relieve the overload is a more natural solution of your difficulty than to change all your lamps and transformers, since 2,000 volts is a much greater strain on the insulation everywhere than 1,000 volts is. 2. What voltage is required to make a 15-inch spark, such as is given by a static machine? A. We have not exact data at hand for the voltage required to force a spark through 15 inches of dry air under all circumstances. A paper read before the American Institute of Electrical Engineers showed that 150,000 volts were required to force a discharge between points, and that a different pressure was necessary if spheres, disks, etc., were employed. We have from time to time published valuable papers concerning the work of Prof. Trowbridge, of Harvard University, in this direction. These can be had for ten cents each. 3. Is the current or discharge from a static machine giving 15-inch spark, such as is used in X-ray work, dangerous? Will it produce death? A. A discharge through 15 inches of air is a very dangerous current to encounter. Any discharge from a coil capable of giving such a spark should be avoided. The only safe rule is not to touch the secondary while the coil is active; and if necessary to touch any part of the apparatus, to place the hand not in use behind the back. No circuit can then be made through the body from arm to arm. 4. Will the 200-volt lamp last as long as the 100-volt? A. One of the largest lamp makers says of 200-volt lamps: "Owing to the increased strain to which the carbons or filaments are subjected by the high voltage, these lamps are uncommercial except in the lower efficiencies. The efficiency of our regular product is 4 watts per candle, and in its average life and maintenance of candle power it corresponds to our standard 100 to 125-volt 3.1-watt lamp." This shows that it will cost more to run a 200-volt lamp than a 100-volt lamp for the same candle power.

(8235) C. D. asks: 1. What point below the freezing point do air, hydrogen, nitrogen oxygen, become liquid? A. These temperature points are very nearly as follows in Fahr. degrees, below zero: Air, 312; hydrogen, 422; nitrogen, 317; oxygen, 297. 2. Please give me the address of a reliable company that sells chemicals and chemical apparatus. A. You would better deal with a firm in the city near your home than to buy at a distance and pay transportation charges. Our advertising columns very often contain the advertisements of these dealers. We do not advertise dealers in the Notes and Queries column. 3. Where can I get some books on argon, helium, neon, krypton and xenon, and give me the prices of them? A. We can send you many valuable papers on the rare gases of the atmosphere which have appeared in the SUPPLEMENT. Among them are argon, Nos. 1000, 1001, 1002, and others, price ten cents each; helium, Nos. 1056, 1057, price ten cents each. 4. What kind of chemical books, as organic chemistry, etc., so I can find liquid formene? What is formene? A. Formene is a tetrachloride of carbon, $CC1_4$. Its preparation can be found in the Dispensatory. Its properties are those of an anæsthetic, similar to those of chloroform, soothing the pain of neuralgia and even causing insensibility. As it has been the cause of death also, it is not used by physicians. It is not a substance for an amateur to meddle with. 5. What are the uses of liquid air? A. At present liquid air is not put to any commercial use.

(8236) C. J. K. asks: I beg to inquire if you can suggest anything that I can use for a reflector in place of plate glass where the size required, 10 feet x 12 feet, makes plate glass impracticable to handle? A. Glass is the best material for a reflector, since it does not tarnish with exposure to moisture and can be easily cleaned. It would not seem to be necessary to have a single piece of glass for a reflector 10 x 12 feet. The difference could not be told if there were a large number of pieces of glass set edge to edge in the frame, making a total area as great as desired. This has been done in the various solar engines which have been built. We do not think any artificial glass would answer your purpose.

(8237) J. R. H. asks: Do you have a SUPPLEMENT that treats of intercommunicating telephones and setting up and construction of same? A. We have no article giving practical details on this point. You can find various systems described in Miller's "American Telephone Practice," price $3 by mail.

(8238) J. T. R. writes: I have a primary battery of eighteen cells; two series of nine connected in multiple, i.e., two positive and two negative wires connected. These are used to charge a secondary battery of three cells of chloride accumulator. The voltmeter indicates 6.6 volts at storage battery and 6.5 volts at terminals of primary battery. Is my primary battery large enough, and what should be the potential of the charging plant described above? A. A storage battery should have a charging current with a pressure of 2½ volts per cell. Three cells require 7½ volts. The maximum charging rate should be 6½ amperes per square foot of surface of positive plate, reckoning both sides. You probably fall short in both pressure and current.

(8239) C. J. H. asks: What is the most desirable formula for making soap bubbles? I am in doubt in regard to the amount of glycerine and soft soap to use and as to whether there were any other ingredients that could be added to advantage. A. A good soap bubble solution is not to be obtained by simply mixing soft soap and glycerine. It is very difficult to secure a good solution. Only the purest oleate of soda, or the best white soap, white Castile for example, can be used. Only the best glycerine can be used. Price's glycerine is reliable. The manipulation is tedious. If, however, you wish to undertake it, proceed as follows: Take the purest caustic soda 1 part, and dissolve in distilled water 40 to 50 parts. All parts by weight, of course. Take pure oleic acid. Set it for a few days in a refrigerator and decant the clear fluid, if a separation takes place. Of this take 7 parts, and mix with the soda solution. Shake till the reaction is complete. Now add water up to 350 parts with the previous water. To two measures of the oleate of soda add one measure of Price's glycerine. Run no risk with poor glycerine. Let this stand a few days in a cool place, and siphon off the clear solution, which is to be used for soap bubbles. Some add a little ammonia to this, but it works well as we have given it.

(8240) W. J. B. asks: Is it preferable to have all south poles on one side and all north poles on the other to work independent armatures suspended above them, or will alternate polarity, north and south, give as good results? A. We do not see that it makes any difference in which way the several armatures are connected up, so long as each magnet works by itself, as your sketch shows that it does. It is more symmetrical to connect all the same, and then in any repair you will know from what point each wire comes.

(8241) F. S. asks: 1. Is there any destructive local action in a storage battery between the oxide filling and the lead alloy of the plates? A. No. 2. Will the presence of a saturated wooden diaphragm increase or diminish the resistance to a current passing through a liquid? A. It increases the internal resistance.

(8242) B. W. L. asks: If a bridged, grounded telephone wire came in contact with one wire of a lighting circuit carrying 5,000 volts, would there be any disastrous effects to either? A. It would be very bad for the telephone. You would need to put in a new one, since there would not be much left of the old. 2. If one wire of this lighting line were to break and fall across the telephone wire, what would be the probable effect? A. If these wires were bare, the best course would be to call out the fire department immediately. In the description which you give of what took place in your case, we judge that there was no contact of bare wires, and perhaps no wires came into contact at all. The swinging of the light wire near your telephone wire would produce all the phenomena you describe; while the fact that you could get no circuit from the ground showed that the wire had not broken and fallen anywhere along the line.

(8243) T. D. asks: In a perfect compound dynamo, would the neutral points vary with the load? A. Yes.

(8244) H. E. T. asks: 1. Is there an alloy approximately as soft as lead, and as tenacious, malleable and ductile as copper? If so, what are the properties of the alloy? A. There is no alloy known to us that is as soft as lead and as tenacious as copper. The alloys of lead and copper have no commercial value as a metal and are not in use. We do not know the properties of such alloys. 2. Is there any need (commercially speaking) now of a telephone repeater, since Dr. Pupin's invention? In other words, could a telephone repeater have any other use than to increase the distance at which speech may be transmitted? A. There is the same need that there has always been. If such an instrument can be invented, it will enable speech to be transmitted not only to greater distances, but at a much less cost than the system to which you refer.

(8245) J. M. S. writes: I have a small electric mouth lamp that when connected up with an alternating 104-volt current, by means of a rheostat, requires from 3½ to 4 volts to light it. Now what I want is to make a rheostat by covering either a piece of wood or iron with asbestos, and then placing same in a lathe and winding it with German silver wire, so as to be able to cut the 104 volts down and not burn out my lamp. Can you inform me what gage wire and how much of it will take to accomplish the desired results? A. We cannot give exact data for a coil such as you require, since we do not know what the current is which you use. But you can proceed as follows: Take 24 B. & S. German silver wire, which has 3 feet to the ohm. Provide 375 feet, and wind into the coil as you propose. You can arrange a switch so that the current may be adjusted; that is, make a variable rheostat; or you can by testing find what amount will be needed to have the light burn properly. You are probably aware that the more economical way is to have a small transformer for your lamps. Such lamps can be run with a battery also.

(8246) M. McC. writes: A positive remedy for carbon brushes sparking is to soak the brushes for 24 hours in ordinary machine oil. Complaints I have read in columns of the SCIENTIFIC AMERICAN prompts the above and should be generally known. I had the same trouble and it occurred to me to try above remedy, and I find it does avoid sparking positively. A. We are not able to indorse this as a sovereign remedy for all diseases of dynamos which show themselves by the symptom called sparking. Machine oil can only act as a lubricator, and sparking may be due to a cause deeper than the surface of the armature.

(8247) F. H. asks: Will you please tell me what kind of metal to use on contact points on a gasoline engine electric igniter, and where to purchase the same? A. Always use platinum at the contact points for breaking a circuit where there will be a strong spark. Any dealer in gasoline engines who advertises in our columns can furnish the article. So also can dealers in electric materials.

(8248) A. S. asks: 1. Would ten cells be sufficient to run a six-candle lamp (10 volts, 1.5 amperes)? If not, how many would be required? A. No. Your lamp requires 1.5 amperes. This battery furnishes 30-1000 of an ampere, or about one-fiftieth as much current as is needed for the lamp. 3. How shall I prepare the pastes used in the upper and lower spirals? A. This battery is useful for testing purposes only, as the description states. The paste is prepared by mixing the solid minium or litharge into a paste with dilute sulphuric acid. This is the method in all storage batteries using such pastes. 3. What is used as the electrolyte, and how is it made? A. Dilute sulphuric acid. You will have to buy the acid. You cannot very well make it. 4. Where could I get the battery charged? A. Charge the battery with a primary battery. A gravity battery is as good as any for the purpose.

(8249) N. D. writes: In your issue of April 13 you mention sulphides of barium and calcium, and state "when properly prepared." Are there any special directions for preparation, and how? A. To prepare a phosphorescent calcium sulphide, calcine clean oyster shells in order to burn out all but the calcium carbonate. Then reduce the shells to a fine powder by pounding or grinding. Place this powder in layers in a crucible with flowers of sulphur. Cover the crucible to shut out the air, and heat to dull redness for half an hour. Let the whole cool while still covered, and transfer the calcium sulphide formed to a glass bottle, which cork tight to prevent the accession of moisture. Barium sulphide should be formed from witherite and sulphur by heating in a crucible in the same manner.

(8250) W. M. R. writes: I made some little time back the eight-light dynamo described in your valuable paper, designed by Hopkins some twelve years ago, or so. Having studied electricity at University College, London, I made some alterations in the design of armature which I think have made material improvement in dynamo. The alterations were these: Instead of using the washers as suggested, I cut washers out of 20-gage charcoal iron, using varnish for insulation. These I fastened on to the armature by thick-end washers engaging a screw on armature shaft. After getting all firmly screwed up, I put into lathe and slotted out 24 grooves the breadth of 4 wires and 8 wires deep, and in these I wound the wire very carefully. By this arrangement I was enabled to run the armature with iron 1-16 inch distant from cheeks of field magnet. I turned the field magnet upside down, with yokes firmly bolted to base plate, from which rose two pedestals (hollow) forming bearings for the ends of armature. I arranged the bearings with an endless chain dipping six inches into oil chamber, with the result that I can light up 50-volt lamps to full brilliancy at a speed of 1660, instead of 2200, the speed mentioned in your article. I have had the machine lighting up my house, driven by a Pelton wheel, for several months, and the bearings have not an atom of shake and have only been filled up with oil once, as it circulates and runs back again. I thought possibly some of your readers would like to hear of my results. I would advise anyone attempting to make the machine to get the segments for commutator cast separate. I tried both ways and found the latter preferable. I made the commutator much larger than the design. A. Of course, the iron-clad armature is an improvement over the old form of a dozen years ago. The results of the alterations are very satisfactory.

(8251) J. M. S. asks: 1. What size German silver wire and how long a piece should I use to wind a rheostat to reduce an alternating current 7200 amperes, 104 volts, down to 2 volts? Also size and amount of iron wire for above results? A. The use of a choke coil is not the most economical way to reduce from 104 volts to 2. A simple mode of getting the result would be to put a wire in series with an incandescent lamp, and take a shunt from the wire at two points which have a resistance between them equal to about one-fiftieth of the resistance of the lamp. The best way, however, is to obtain a transformer from the company supplying the current, which will give you this rate of transformation. If your current should happen to be transformed from 2000 volts to 104 a second transformer like the first would carry it down to about 5 volts, which perhaps is near enough to your limit for your use. 2. How shall I proceed to construct an appliance for heating say a glass of water, using same current, amount, size and kind of wire? A. This you can do by means of a small coil of wire in series with a lamp. An arc lamp would give a quicker result. With an arc lamp use 12 or 14 B. & S. German silver wire. With an incandescent lamp use 18 or 20 wire.

(8252) H. S. asks: Will you kindly tell me through your Notes and Queries column what editions of the SCIENTIFIC AMERICAN or SUPPLEMENT (if any) contain drawings for the building of a 110-volt dynamo for lighting purposes. A See SUPPLEMENTS 844 and 865, price ten cents each.

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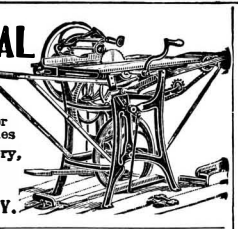

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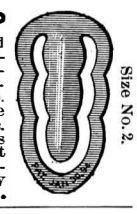

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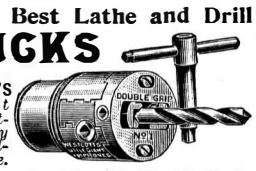

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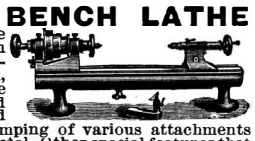

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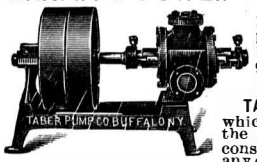

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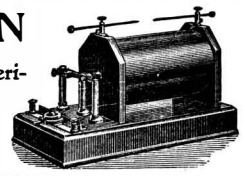

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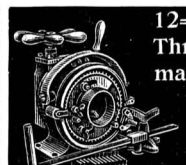

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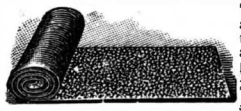

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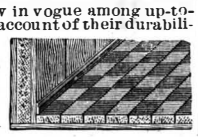

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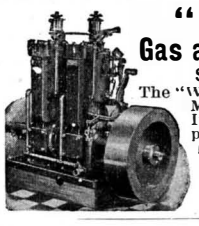

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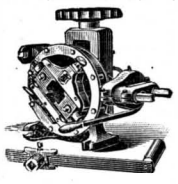

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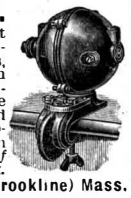

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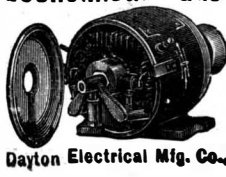

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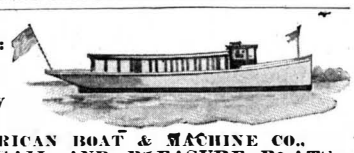

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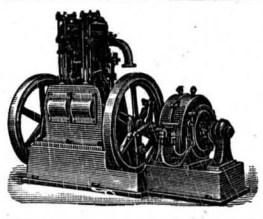

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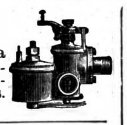

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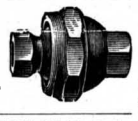

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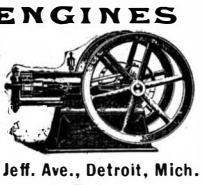

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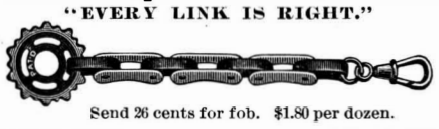

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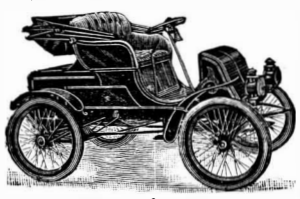

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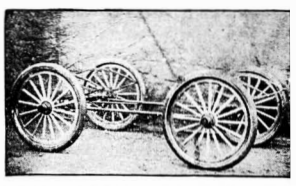

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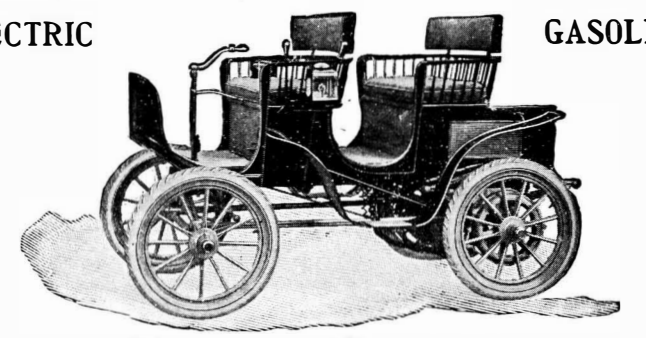

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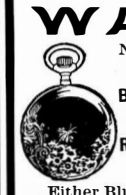

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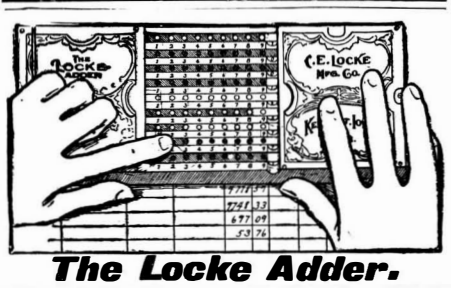

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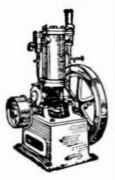

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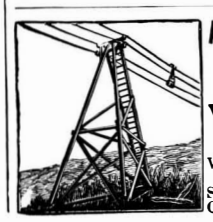

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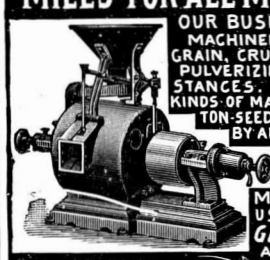

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